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Interactions between Languages in Verb- and Pronoun-Agreement in Bilingual Sentence Production

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Tables and Figures

Declaration

This thesis has been composed by myself, and the research presented herein is my own. No portion of the work has been submitted for any other degree or professional qualification.

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Abstract

This thesis investigates how fluent bilinguals make use of the grammar of their two languages when they construct verb- and pronoun-agreement only in one language (*monolingual mode*) or in both their languages (*bilingual mode*). We are particularly interested in the impact of the non-response language in sentence processing on the response language. Bilingual research has provided evidence for language integration in bilingual speech (e.g., Hartsuiker, Pickering, & Veltkamp, 2004) which is also consistent with the phenomenon of *code-switching* whereby speakers can use elements of each language in producing mixed-language utterances (e.g., Myers-Scotton, 2002). So far, studies at the lexical level have provided support for parallel language activation (e.g., Colomé, 2001), yet the issue of whether activation of either language can be strong enough to influence the workings of the other is still in dispute (e.g., Hermans, Bongaerts, de Bot, & Schreuder, 1998, but see Costa, La Heij, & Navarrete, 2006).

In three separate sections of the thesis we employ a sentence-completion paradigm widely used in monolingual agreement literature (Bock & Miller, 1991) to examine language interaction effects in the monolingual and the bilingual modes of speech (Grosjean, 2000). English-Greek and Greek-English fluent bilinguals produced completions to singular or plural subjects when the number of the translation was either the same or different, and when their completion either did or did not switch languages. The first section investigates whether there is influence of the divergent number properties of the non-response native language (L1) on verb-agreement in the response second language (L2). The results of Greek-English bilinguals show influence of the underlying number of the L1 on completions in the L2. We interpret this in terms of a markedness account (e.g., Eberhard, 1997) whereby parallel activation and competition between an L2 singular subject noun and its L1 plural translation results in plural verb-agreement because the singular form is more vulnerable to the marked plural form. English-Greek bilinguals who perform on the same monolingual mode do not show influence of their L1 when speaking in the L2 (Greek). We attribute this finding to a difference of morphological/inflectional properties between the two languages which renders a language that displays fewer overt markings (English) easier to control when utterances are produced in a language that displays more overt markings (Greek) (e.g., Vigliocco, Butterworth, & Semenza, 1995).

The second part of the thesis explores whether the influence that we observed in the monolingual mode is enhanced in the bilingual mode, in a sentence-completion task where both languages have an equal share of activation and participation and where code-switching is also involved (i.e., the presented subject noun is in one language and the produced verb in the other). The results of the corresponding single-language utterances provide evidence of influence of the non-response language in both groups of bilinguals. Comparable but enhanced effects occur for code-switched utterances, with agreement appearing to depend on language dominance and morphological and notional salience.

The final part of the thesis investigates whether pronoun-agreement is subject to the same effects as verb-agreement (e.g., Bock, Eberhard, & Cutting, 2004), and whether pronouns are processed in the same way by speakers of different L1. The results replicate the findings from verb-agreement in both bilingual groups with English-Greek bilinguals showing more influence of the notional number of the L1 during code-switched speech, thus providing support for a claim that pronouns are more likely than verbs to be prone to semantic rather than syntactic agreement (e.g., Corbett, 2003).

This thesis demonstrates that the grammar of both languages is activated when fluent bilinguals produce utterances in either the monolingual or bilingual mode. By inducing code-switched speech under controlled experimental conditions in the same discourse session as single-language speech it also provides support for influence of the non-response language, the level of which may be regulated by factors such as language dominance, feature salience, and processing requirements of the task at hand.

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CHAPTER 1
Introduction

1.0 Chapter Overview

This chapter gives a brief introduction to the notion of language interaction, especially that of influence of the non-target[1] language in bilingual speech production at lexical level, and outlines why it is important to be further considered at sentential level. I explain the psycholinguistic approach adopted to examine this phenomenon, and introduce the issues to be addressed by the thesis.

1.1 Language Interaction in Bilingual Speech Production

This thesis is fundamentally about how the syntax of a bilingual's non-target language may affect the syntax used when producing utterances in the target language. In particular, the main focus of interest is whether and to what extent mismatched grammatical properties of two language systems may interact when a bilingual computes subject-verb agreement in one or both her languages.

So far, there has been an abundance of evidence suggesting that bilingual speakers consider the non-target language with respect to lexical processing. For example, words in one language are recognized faster if they are preceded by semantically-related or form-related primes in the other language (Kirsner, Smith, Lockhart, King, & Jain, 1984; Kroll, 1990; Kroll et al., 1992; Williams, 1994). Also, unattended words in one language can influence processing of an attended word in the other language (*negative priming*) (e.g., Fox, 1996). Further evidence that the bilingual lexicon is at least partly integrated comes from studies using tasks like picture naming, translation, word association, and lexical decision (e.g., Potter, So, Von Eckhardt, & Feldman, 1984; Van Hell & Dijkstra, 2002). However, little is known about syntactic integration between languages.

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[1] Throughout the thesis the terms *non-target*, *non-response*, and *non-intended* will be used interchangeably to denote the language a bilingual speaker does not intend to be using at the time, either within a natural discourse environment or during an experimental task (in contrast to *target*, *response*, and *intended* language).

There are some recent demonstrations that syntactic (or structural) priming, that is, re-use of previously produced structures (Bock, 1986), takes place between languages. In a monolingual study, Branigan, Pickering and Cleland (2000) found that participants using a matching-card task in a dialogue tended to repeat each other's grammatical choices. Hartsuiker, Pickering, and Veltkamp (2004) applied their method to bilingualism to test whether syntactic representations can be shared across languages (*shared syntax* account) or not (*separate syntax* account). The authors asked intermediate Spanish-English bilinguals to describe cards to each other. Namely, a confederate would describe a picture in Spanish (active/passive transitive sentences or active intransitive sentences) and the naïve participant would describe a picture in English (active or passive). According to the *shared syntax* account, if the rules of active/passive construction were shared between the two languages, cross-linguistic syntactic priming should be yielded. On the other hand, the *separate syntax* account would not predict occurrence of priming because the constructions in question would be stored and accessed separately for each language. The results showed that participants who heard a picture description in Spanish were likely to use the same grammatical form (active or passive) when describing a subsequent picture in English. Thus, Hartsuiker et al. (2004) concluded that this was evidence for integrated syntactic representation between languages.

Similarly, Loebell and Bock (2003) found within-speaker priming between German and English picture descriptions, Meijer and Fox Tree (2003) found syntactic priming between Spanish and English sentences using a sentence recall task, Desmet and Declercq (2006) primed relative clause attachments from Dutch to English, and Salamoura and Williams (2006) primed prepositional object and double object datives from Dutch to English. Such priming suggests that grammatical representations or procedures can be shared between languages, and that they interact with each other during sentence processing.

Psycholinguistic evidence for shared lexical and syntactic information across languages is also consistent with the phenomenon of *code-switching* (CS) (*intra-sentential* and *inter-sentential*), whereby speakers of two languages produce "mixed" utterances that can involve some words from each language or some aspects of the grammar of both languages. Linguists agree that code-switching appears to support sharing of different types of linguistic information between languages (e.g., Dulay, 1982; Myers-

Scotton & Jake, 2001). However, bilingual and code-switching research to date have not investigated how different levels may interact during a complex but central aspect of sentence production, that is, verb- and pronoun-agreement, nor have they indicated what effects such sharing has on the production process.

1.2 Influence of the Non-Target Language

We explained above that language interaction is unavoidable for speakers of two languages. The main interest of our research lies in the effects such an interaction may have on bilingual speech production, and what these effects may tell us about sentence processing in bilinguals.

What we know about the effects of language interaction or so-called *interference*[2] in bilingual speech production has been informed by work in linguistics and second language acquisition (e.g., White, 1996; Pienemann, Di Biase, Kawaguchi, & Håkansson, 2005), and sociolinguistics (e.g., Lambert, 1974; Thomason, 1991). Language interaction has been attested at various levels of language representation and production (e.g., semantics, syntax, morphology, prosody), in spoken and written modalities, in both children and adults. This typically arises when there is some kind of mismatch between the languages in contact (Romaine, 1996; Butler & Hakuta, 2004) and the direction of influence is usually from the L1 to the L2 (e.g., MacWhinney, 1992; Desmet & Declercq, 2006). However, there is also some evidence for influence in the opposite direction (Gutierrez & Silva-Corvalàn, 1993), as well as bi-directional influences (e.g., Pavlenko & Jarvis, 2002; Mennen, 2004). Interference has been distinguished into *static* and *dynamic*, the former referring to permanent traces of one language upon another (e.g., accent, meaning interpretation of specific words), and the latter reflecting temporary influences from the non-response language on the response language (e.g., different syntactic structures, different gender) (Grosjean, 1995).

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[2] The term *interference* has been interchangeably used in linguistic and second language acquisition literature with the terms *transfer* and *borrowing* to denote linguistic influences that occur as a result of the use of two or more than two languages in the same cultural environment.

However, standard *psycholinguistic* theories of language processing have traditionally had little to say about the effects of language interaction for language units larger than a word or word-pair. This is probably due (at least in part) to the fact that following the advance of monolingual research, bilingual research has focused on the study of mechanisms that underlie word comprehension and production, leaving relatively unexplored bilingual sentence production. Moreover, the lack of a comprehensive model of bilingual speech production has led psycholinguists to develop experimental paradigms to investigate language interaction in small language-chunks which *ipso facto* may not be able to account for the full range of influences on bilingual syntactic representation and processing (Costa, 2005). In addition, as we shall see in the literature review, the majority of the studies that have explored language interaction effects have used the picture-word interference paradigm. However, use of this paradigm has led to contradictory interpretations that result from a difficulty of identifying precisely the locus of the occurring effects (e.g., Costa, Colomé, Gómez, & Sebastián-Gallés, 2003).

A full account of bilingual speech processing will therefore need to consider the extent to which language interaction affects bilingual speech production at a commonly used level of speech (sentential level), and the circumstances under which bilingual speakers may be more or less affected by the grammatical features of the non-target language. This thesis aims to address these questions by building upon research at lexical level and extending it to sentential level, while using a different experimental paradigm.

1.3 Questions to be addressed in the Thesis

This thesis experimentally addresses a number of issues relating to language interaction in bilingual speech production. The methodology used here is a sentence-completion task, a traditional methodology in the study of the processes of agreement in monolinguals (Bock & Miller, 1991). Fluent Greek-English[3] and English-Greek bilinguals read aloud the subject of a sentence which appears on a computer screen and make a full sentence by producing a verb and a complement (Expts. 1-5), or read aloud a sentence

[3] We are using the convention of giving the L1 first and the L2 second (e.g., Greek-English bilingual means a bilingual whose L1 is Greek and L2 is English).

and construct a tag question (Expts. 6-9). In the experiments we report here, we manipulate the grammatical number of the subject noun (same or different from its translation equivalent) as well as the language of speech production (same or different from the subject noun). Apart from the actual experiments, we also conduct oral (involving translation) and written (norming studies, forced-choice questionnaires) pre-tests and post-tests. By recording and analyzing the utterances produced by the bilingual speakers, we can have a highly informative picture about the construction of agreement and hence the representation of syntactic information in bilinguals.

The thesis investigates the following questions concerning the effects of language interaction in bilingual sentence processing. Chapter 3 explores whether there is evidence of influence of the non-target language (here L1) when bilinguals produce utterances in the target language (L2) in S-V agreement. The results provide evidence for language integration when the number of the subject noun is the same across languages, and for influence of the non-target language (only for Greek-English bilinguals) when the number of the subject noun in the L2 is singular but its translation in the L1 is plural. We attribute these effects to the difference in morphological/inflectional properties between Greek and English which render the former more difficult to control and more likely to override the number of an unmarked form of the latter (e.g., Bock & Eberhard, 1993).

Chapter 4 asks whether any influence in the monolingual mode might be enhanced in the bilingual mode where both languages are used in single-language as well as code-switched utterances. That is, speakers are asked to complete subject noun phrases in the same language as the subject noun as well as in a different language than the subject noun. As this thesis is the first to examine code-switched sentence production under controlled experimental conditions, we are interested in the role and share of contribution of each language in each switch direction (L1-L2 vs. L2-L1) during verb-agreement construction. The results of both bilingual groups suggest that the influence of the number properties of each language onto the other in each switch direction is dependent upon language dominance, and morphological or notional salience.

In Chapter 5, a series of experiments is presented that investigates whether verb- and pronoun-agreement are subject to the same effects of number divergence and language interaction in the bilingual

mode. Using the same sentence-completion paradigm in which Greek-English and English-Greek bilinguals are asked to add a tag question to a clause either in single-language or in code-switching, we examine number agreement used with the same subjects that we employed in the previous experiments for verbs, now serving as pronominal antecedents. We also look at whether the two groups of bilinguals process pronouns in the same way or not. The results that we obtained from both groups replicate those of experiments on verb-agreement with English-Greek bilinguals providing evidence of reliable notional influence during pronoun-processing (e.g., Eberhard, Cutting, & Bock, 2005). This accords with a claim that pronouns are more prone to notional influence than verbs (see Bock et al., 2006, for a review).

In Chapter 6, we summarize the main findings of this thesis, interpret our results by proposing a model of bilingual sentence construction, and discuss directions for future research. We will see that grammatical mismatch between languages in connection with the discourse environment have pervasive effects on grammatical and conceptual aspects of language production. These experiments suggest that language interaction effects in bilingual sentence processing may be modulated by factors such as language dominance and morphological/inflectional properties of that language, whether speakers produce both languages during the same session or not, and by how cognitively costly the language production task is.

CHAPTER 2
Literature Review

2.0 Chapter Overview

This chapter provides an introduction to the language interaction literature, briefly presents what is assumed about monolingual speech production, and discusses some of the empirical evidence used to support bilingual speech production. In 2.1 I present how language is represented and produced according to monolingual production models. In 2.2 I clarify certain notions relating to bilingualism (e.g., which speakers are considered "bilinguals" and which mode of speech is defined as "monolingual" vs. "bilingual"). In 2.3 I discuss how monolingual production assumptions are adapted by bilingual speech production models. I describe existing theories and approaches on word and language activation, competition and selection in bilingual speech production, and I present some of the empirical data used as evidence for and against influence of the non-target language.

Section 2.4 introduces another kind of bilingual speech production, that of *code-switching* (CS), and discusses the accounts that have been put forward to explain how utterances are computed during this linguistic phenomenon of mixed-language involvement. In 2.5 I outline a range of studies on monolingual agreement showing evidence of semantic, syntactic and morphophonological influence on sentence processing, and discuss how we can use this evidence to develop an account of bilingual agreement while also considering language interaction effects. Section 2.6 expands upon the specifics of the current study that we presented in the introduction of the thesis.

2.1 Monolingual Speech Production

Language production appears to be a very simple and natural process for both speakers and listeners. However, a great deal of research has been carried out to identify the stages our thought goes through before we are able to communicate meaningful utterances to our interlocutors. Most models of monolingual speech production assume that lexical access is realized into two stages of processing (but see Pickering, Branigan, & McLean, 2002): (i) the stage where semantically and syntactically specified

words are selected to convey the message speakers want to communicate (*Grammatical Encoding*), and (ii) the stage where these words are phonologically represented (*Phonological Encoding*) (e.g., Garrett, 1975; Bock, 1982). Of course, a lot more processes take place within each of these stages (there are often assumed to be four levels of processing as we shall describe below), and a number of different assumptions have been made in speech production literature to explain each of these processes.

In particular, the initial idea of what we want to talk about has the form of a pre-verbal message. This *conceptual level* comprises various domains of knowledge such as encyclopaedic, contextual, and situational information (Bierwisch & Schreuder, 1992). We should note at this point that information in models of lexical access usually corresponds to nodes. The intended message is "dressed" by the selection of specific lexical items amongst other semantically-related items which have also received activation from the conceptual level corresponding to the meaning a speaker wishes to convey (e.g., Garrett, 1980; Rumelhart & McClelland, 1982; Dell, 1986; Roelofs, 1992). That is, if a speaker wants to name a picture of HAIR, the conceptual level will spread activation not only to the lexical node *hair*, but also to other highly semantically-related nodes such as *head*, and so on (see Fig. 1). These lexical items (*lemmas*) carry grammatical information about their nature (e.g., noun, verb, etc.) as well as syntactic information about other items they can combine with (e.g., the verb *give* typically takes a direct as well as an indirect object) and the kind of dependencies they may form (e.g., the subject of the verb is usually put in the nominative and the object in the accusative) (Pickering & Branigan, 1998, but see Caramazza, 1997, for a different proposal in the *Independent Network* model). Following the assignment of grammatical roles and syntactic functions at the *functional level*, the selected constituents will then have to be placed in the right order (creating a control hierarchy for phrasal constituents) and be inflected at the *positional level*. The retrieval of lexical items and the syntactic planning of the intended message we have described so far constitute the so-called *Grammatical Encoding* (Bock & Levelt, 1994). *Phonological encoding* takes place at the *phonological level* where language constituents acquire their phonological and prosodic features before they are finally articulated (Dell, 1986; Levelt, 1989; Levelt, Roelofs, & Meyer, 1999).

Two broad views have been expressed as to the way information from one level of representation is processed and passed to another. The *minimalist* approach assumes that only information that is relevant to each level (e.g., syntactic, phonological) is currently processed at that level and that the mechanisms of different levels cannot interact with one another (Garrett, 1980; Fodor, 1983; Levelt, 1989). On the other hand, the *maximalist* view postulates that any level of representation may share its information with another through *cascaded* activation (preactivation of target units at a subsequent level) and feedback (Vigliocco & Hartsuiker, 2002). Thus, information that for some reason has been lost at one level can be recuperated from integrated information at another level (Dell, 1986; Bates & MacWhinney, 1989).

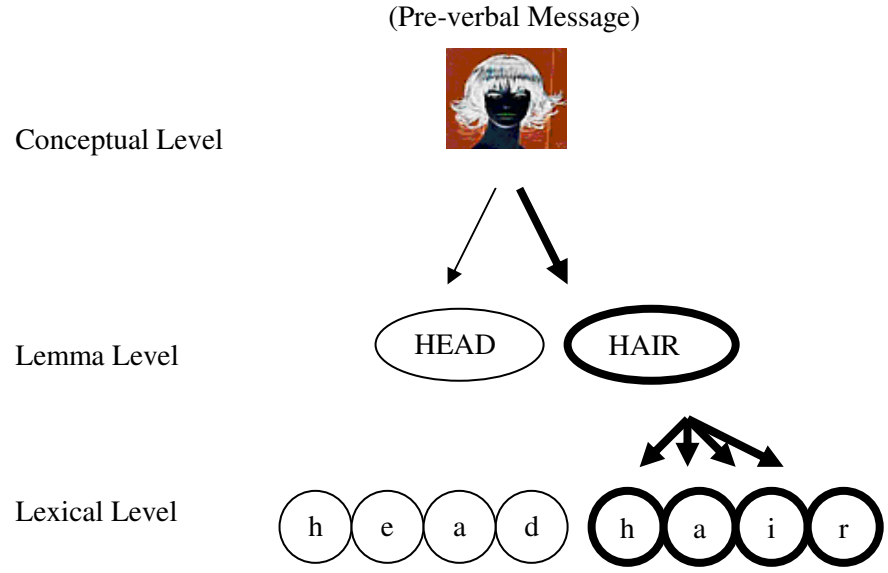

Figure 1. Schematic representation of the monolingual lexical production system. Bold form indicates higher level of activation.

2.2 Bilingual Speech Production: Variables and Definitions

Bilingual speech production is assumed to proceed similarly to monolingual speech production (e.g., Poulisse, 1997). Yet the fact that the production system is exposed to information available from two sources (two languages) adds a certain degree of complexity to an already multidimensional process. For a bilingual to be able to communicate succesfully in either of her languages, she needs to be able to access the relevant information that will help in the encoding of her speech intention, inhibit irrelevant

information, and control the language of the output (Bialystok, Craik, & Viswanathan, 2004). In addition, as we shall see further on, other factors relating to bilingualism such as the fluency a speaker has in each of her languages and the discourse environment within which a bilingual makes use of either or both her languages may affect speech production. Before I discuss what bilingual models assume about language production, I will briefly clarify certain notions I will be referring to throughout the thesis.

2.2.1 Bilinguals and Second Language Learners

The variety of terminology used for speakers of two languages mainly depends on the study field and its adopted approach towards this linguistic phenomenon. For example, in linguistics the term *bilingual* has been traditionally used to describe people with "native-like control of two languages" (Bloomfield, 1933). That is, it refers to people who speak two languages from birth usually as a result of having each parent speaking each of their languages.

In the present thesis, we make use of the term *bilingual* as it is used in the field of psycholinguistics to denote a person who has command of two languages (what would be defined as a *second language learner* according to linguistics) (Grosjean, 1995). This allows distinguishing between "levels" or "degrees" of bilingualism (Hakuta, 1986; Bialystok, 1988; Romaine, 1996) depending on the speakers' language skills. Moreover, this distinction explains the use of terminology such as an *unbalanced* or *non-dominant* bilingual (meaning a speaker of two languages having a differential degree of fluency in each one, with the native language usually being the most frequently used and most developed one) vs. a *balanced* or *dominant* bilingual (meaning a speaker who is equally fluent in two languages which are equally developed). This distinction in terminology often comes up in psycholinguistic studies where the level of fluency of the non-native language has been manipulated (e.g., de Groot, Dannenburg, & Van Hell, 1994; Duyck & Brysbaert, 2004). For the purposes of our study, we will be referring to *fluent* bilinguals, meaning speakers who have acquired an advanced proficiency in their second language, as assessed by various language tests we administered prior to and following each experimental session of our study.

2.2.2 Bilinguals' Modes of Speech

Another very important notion relating to bilingualism which will frequently come up in the thesis is that of language *mode* which denotes bilinguals' language behaviour in a discourse environment (Grosjean, 2000). As a monolingual sometimes has to adjust her way of speaking to her interlocutor's needs in order to be understood, a bilingual likewise may choose to use different modes of speech depending on the discourse requirements. For instance, if a Greek-English bilingual has to interact with an English native speaker, she will have to use a *monolingual mode* of speech, that of production entirely in one language (single-language production); that is, the language of her interlocutor (i.e., English). On the other hand, if the same bilingual finds herself in a group of other Greek-English bilinguals, she may choose to alternate between her two languages, thus producing utterances in either Greek or English (inter-sentential code-switching), or she may even use features from both her languages in the same utterance (intra-sentential code-switching). The choice of use of two languages in the same discourse session constitutes a case of *bilingual mode*, that is, the produced speech is in the bilingual mode.

It is assumed that when a bilingual produces speech in the bilingual mode, both languages are activated to some extent, yet the target language, that is, the language of the output, is always activated to a higher degree than the non-target language (Paradis, 1994; Green, 1998). In the monolingual mode, the non-target language is somewhat "deactivated" (Grojean, 1997a). However, as we shall see in section 2.3.2.1, evidence from speech and gender agreement errors of the influence of the non-target language on production in the target language provides support that the non-target language, especially if it is the L1, cannot be totally deactivated (e.g., De Bot & Schreuder, 1993). According to Grosjean (1998a, 2000), language mode constitutes a continuum whereby the level of activation of each language is modulated depending on linguistic and extra-linguistic (social and psychological) factors. Therefore, the variable of what mode a bilingual is in during a language task should be seriously taken into account and controlled for, particularly in language interaction experiments.

2.3 Models and Assumptions of Bilingual Speech Production

Certain proposals have been put forward to account for bilingual speech production (De Bot, 1992; De Bot & Schreuder, 1993; Poulisse & Bongaerts, 1994). Despite their differences mainly on the issue of how language information is organized at each level of representation (shared or separately for each language), all the proposed models are based on the most influential model of monolingual speech production (Levelt, 1989; Levelt et al., 1999). Thus, in a way similar to word representation in monolingual production, the bilingual production system is assumed to proceed from the intended message one wishes to convey (conceptual level) to the activation of the corresponding lexical nodes from each language lexicon, where lexical, grammatical, and combinatorial syntactic information regarding the possibilities of verb construction is stored (lemma level). Activation from the lexical nodes cascades to the next level (phonological) where the intended message will be phonologically encoded for articulation in the appropriate language.

Two questions are crucially important during the process we just described: (i) how is lexical selection achieved in the intended language so that the speaker normally uses the correct language? In other words, how is the competition between the activated candidates from both lexicons resolved in favour of the lexicon of the language-to-speak? (ii) If both languages of a bilingual are activated during speech production, could there be evidence of influence of one language in the processing of the other? If so, under what conditions might we expect such effects to be more enhanced? The focus of our research is to investigate directly the second question of language interaction. However, assumptions of existing literature on the issue of word selection and language control will be also discussed in the following section.

2.3.1 Word Selection and Language Control

In the bilingual literature, it is generally agreed that there is a common conceptual (or semantic) store where the meaning of words and sentences is organized (see Francis, 2005, for a review). There is also agreement on the assumption that this store feeds the activation of multiple semantically-related lexical nodes, as is the case with monolingual speech production. In the case of a bilingual speaker, this multiple

activation spreads to both language lexicons since both languages have access to the conceptual store (see de Groot, 2002; Kroll & Dikjstra, 2002, for reviews). With respect to the above, two questions can be raised. First, how is a speaker able to select and produce the intended word amongst all other candidates? And second, how is language control achieved for a bilingual speaker? That is, how is the transition from parallel language activation modulated to single-language production?

Most researchers agree that the selected word is the one whose activation exceeds that of other activated words, thus preventing them from being chosen (e.g., Roelofs, 1998; La Heij, 2005). As we mentioned earlier for lexical selection in monolingual speech production, it is usually the case that the most activated word is the one that a speaker wishes to produce; therefore retrieval of that word is relatively fast and easy. But semantic errors do occur sometimes, a fact that points to lexical competition among the most highly activated candidates (e.g., Roelofs, 1992). Where views appear to diverge is on the mechanism that makes possible word and language selection take place. That is, the attention/control mechanism that allows bilinguals to produce utterances in the desired language and avoid interference from the other language (see Finkbeiner, Gollan, & Caramazza, 2006, for a review).

Earlier bilingual accounts of word and language selection did not consider parallel language activation (see Costa et al., 2006, for a recent review). Instead they assumed the existence of a "switch" which would turn each language system on and off depending on bilinguals' wish to speak in one language or another (MacNamara, 1967; Obler & Albert, 1978). This hypothesis was formed from findings showing slower production and comprehension for mixed-language passages than for single-language passages (Kolers, 1966a; MacNamara & Kushnir, 1971), which according to the above authors could be attributed to the time it would take for a "switch" mechanism to turn on and off.

According to more recent views, all necessary information for the selection of the appropriate word (Levelt, 1989; Starreveld & La Heij, 1996) and the appointment of the intended language (Poulisse, 1997; La Heij, 2005) is contained in the preverbal message (but see Dijkstra & Van Heuven, 2002, for comprehension models' assumptions such as BIA or BIA+ in which language information becomes available after lexical selection has taken place). That is, the selection of the intended language is pre-determined quite early, before the lexicalization process takes place. Thus, if a speaker has decided on

the message she wants to convey and the language to express it in, then the conceptual level will take into account these specific concept and language cues and ensure which lexical items of which language should receive the highest level of activation and be selected for articulation.

Two more detailed approaches have been proposed to account for lexical selection and language control in bilingual speech, which place the "bar" of selection at the lexical level. *Language-specific* models assume that there is a language 'tag' attached to each word which signals what language a word belongs to. Therefore, even if activation spreads to both language lexicons, only the word that is language-cued as belonging to the intended language will be selected for articulation. If not, it will be *ignored*, and not constitute a "threat" anymore against word candidates from the intended language (e.g., Costa & Caramazza, 1999; Costa, Miozzo, & Caramazza, 1999). *Language non-specific* models also assume the existence of language tags, yet they postulate that words from the non-intended language are *inhibited*. That is, word activation of the non-intended language is assumed to be suppressed to such an extent that activation of the non-intended language is minimal compared to activation of the intended language, thus making the latter clearly more salient for selection (what Green calls in his Inhibitory Control model (IC) "schema selection") (Green, 1986, 1998; de Bot, 1992; Poulisse & Bongaerts, 1994). To account for the occurrence of language switching (code-switching), some of these authors have suggested that two speech plans (one for each language) are simultaneously formulated, so that when language switching is necessitated, the encoding of a speech plan in one language may cease and give way to the speech plan in the other language (Green, 1986; de Bot, 1992).

However, the easy of switching between languages is not considered to be the same for fluent and less fluent bilinguals (e.g., Green, 1998; Costa & Santesteban, 2004; Costa, Santesteban, & Ivanova, 2006). The IC model, for example, predicts costs, that is, slower reaction time in speakers' responses during L2-L1 language switching. This is explained in terms of the effort that is needed to switch from one language to the other and overcome the inhibition that was previously exerted on what is now the target language. Inhibition is successful when the lemma with the target-tag is selected for output, yet switching costs will be asymmetric for unbalanced bilinguals since it is more difficult to switch from a strongly inhibited language (L1) into the L2. It is important to note that the assumption of asymmetrical switching costs has been based on studies from the field of bilingualism by comparing the performance

of fluent and less fluent bilinguals on word or picture naming during language switching. However, caution is needed so as not to compare this act of "switching" to *code-switching*, because as we shall see in section 2.4 *Code-switching: Cocktail of Languages*, inserting a single word into another's language sentence is not considered an instance of code-switching (e.g., Pfaff, 1979). In addition, speech alternation between languages to communicate a message can be usually performed only by fluent bilinguals (Muysken, 2004).

The issue of how word selection and language control are achieved is far from settled as there are counterarguments against each one of the above accounts that cast doubt on the validity of their premises. More importantly, the linguistic phenomenon of code-switching, especially that of intra-sentential code-switching, constitutes their major challenge. Regarding the "on/off switch" and language pre-determination accounts, we argue that they could hold only for speech production in the monolingual mode. These accounts would have to make additional assumptions to explain how bilinguals manage to modulate their speech in the bilingual mode, especially in intra-sentential code-switching. That is, language pre-selection solely at message level is incompatible with intra-sentential CS in which unexpected language alternation may occur at arbitrary points during bilingual discourse. In addition, the operation of a crude "on/off switch", which stops processing in one language and allows processing in another, cannot explain how elements from each language system are integrated into a unified syntactic structure, either in natural speech or in experimental sessions (see also Muysken, 2000, for a similar view, and Grainger & Dijkstra, 1992, for evidence against language pre-selection from a decision task with English-French bilinguals).

In the same line, a case against *inhibition* and the *language non-specific* account argues that during bilingual speech where speakers may alternate between languages, both languages' lemmas should be activated to the same extent to be able to participate in sentence construction (Roelofs, 1998). That is, the cognitively costly requirements and above all the speed of code-switching have been interpreted as evidence for lack of inhibition (La Heij, 2005). As far as the *language-specific* account is concerned, if words from the non-intended language are "ignored", then we should not expect influence of the non-target language. However, in what follows, we present evidence for language interaction both at lexical level (provided by other colleagues) and at sentential level (provided by our research). Moreover, there

are other factors that need to be addressed more thoroughly which could influence word and language selection in a certain way such as bilinguals' proficiency in the L2, L2 learning environment, contextual cues, and monitoring skills (Kroll & Tokowicz, 2001; Costa et al., 2003; Meuter, 2005).

Another issue that has preoccupied models of lexical selection both in monolingual and bilingual speech production is whether the activation of phonological properties of words is restricted only to the selected lexical nodes or whether it also spreads to the non-selected lexical nodes. An additional relevant question is during which stage of language representation phonological activation takes place (before or after the selection of lexical nodes). Since this topic falls out of the focus of our research, we will not deal with it (but see Schriefers, Meyer, & Levelt, 1990; Levelt et al., 1999, for discrete models' assumptions, and Caramazza, 1997; Costa, Caramazza, & Sebastián-Gallés, 2000a; Costa, Colomé, & Caramazza, 2000b, for cascaded models' assumptions).

2.3.2 Influence of the Non-Target Language Revisited

According to the two most prevalent accounts of language control in bilingual speech, bilinguals manage to produce utterances in one language selectively either because in one account the non-intended language is *ignored*, or because in the other account the non-intended language is *inhibited*. In the *language-specific* hypothesis, where only words from the intended language are considered for production (e.g., Costa, 2005), the non-response language should not be expected to interfere in the lexical access of the response language. That is, bilingual speech production should proceed as in monolinguals. In contrast, following the *language non-specific* hypothesis which assumes that there is competition among all the activated words from the two lexicons and that the word with the highest level of activation is the one that will finally be selected for articulation (e.g., Hermans et al., 1998), we might expect some evidence of "intrusion" from the non-response language. Next, we present empirical evidence for and against each of these hypotheses and predictions.

2.3.2.1 Evidence for Language Interaction Effects

Evidence in support of the *language non-specific* hypothesis and of influence of the non-target language comes from a range of bilingual studies. Poulisse and Bongaerts (1994) analyzed slips of the tongue from Dutch-English speakers who produced utterances in their L2 (English). They found cross-language equivalents of blend and semantic substitution, especially in the group with low L2 proficiency. For example, bilinguals would utter *he cwame* (Dutch *kwam* and English *came*) and *elchother* (Dutch *elkaar* and English *each other*). From this the authors inferred that during parallel language activation when words from both languages compete for selection, less proficient bilinguals are more likely to lose language control over the competitive candidates from the non-target language, especially when the latter is the native language.

Hermans et al. (1998) also found cross-linguistic effects using the picture-word interference paradigm (Stroop interference). Their Dutch-English participants had to name pictures such as MOUNTAIN in L2 (English) while ignoring auditorily presented distractor words from the L2 (Expt. 1) or the L1 (Expt. 2). Thus, in Experiment 1, distractors were semantically related (*valley*), phonologically related (*mouth*), or unrelated (*present*) to the English name of the picture (*mountain*) or phonologically related (*bench*) to the translation of the non-response language (*berg*; 'mountain' in Dutch). In Experiment 2, distractors were semantically related (*dal*; 'valley'), phonologically related (*mouw*; 'sleeve') or unrelated (*kaars*; 'candle') to the English name of the picture (*mountain*) or phonologically related (*berm*; 'verge') to the translation of the non-response language (*berg*; 'mountain'). The authors manipulated the time of presentation of the stimuli (stimulus onset asynchronies, SOAs) to localize at what level of representation language interaction may occur if the translation of the picture name in the non-response language is also activated. That is, they wanted to see whether language interaction would occur during lemma selection and/or during phonological encoding.

The findings from Experiment 1 showed that presentation of L2 phonologically related distractors (*mouth*) facilitated naming in L2 (*mountain)*, and that L2 semantically related distractors (*valley*) slowed down naming. Presentation of L2 phonologically related distractors to the L1 translation of the picture (*bench* vs. *berg*) slowed down naming at SOA 0 m, providing support that the name of the picture in the

non-response language (Dutch) is activated only during the lemma selection process. The findings from Experiment 2 showed that L1 phonologically related distractors (*mouw*; 'sleeve') facilitated naming in L2 (*mountain*), and that L1 semantically related distractors (*dal*; 'valley') slowed down naming. Presentation of L1 phonologically related distractors to the L1 translation of the picture (*berm* vs. *berg*) interfered with naming in the L2 at SOAs -300, -150, and 0 ms, showing that the translation in the non-response language is activated at lemma level. In short, Hermans et al. (1998) interpreted slower reaction times (i.e., interference) as evidence for competition between the words from the two activated language lexicons during lexical selection. The manipulation of SOAs also showed that the activation of a picture noun in the non-response language (Dutch) took place during the lemma selection process of the English translation equivalent, but that the Dutch lemma was not phonologically encoded.

Parenthetically, we note that Costa et al. (2003) replicated Experiment 2 of the above study with Spanish-Catalan proficient bilinguals. Interestingly, they suggested another interpretation for the effects of the phonologically related distractors to the target's translation (*phono-translation effect*) in comparison to unrelated distractors. They agreed that this was evidence for activation of the L1 during L2 production but, adopting a *language specific* view, they argued that phonological interference could have occurred due to the activation of the phonological properties of the target's translation, without having to resort to a lexical interference interpretation.

Another study in support of the *language non-specific* hypothesis is that of Colomé (2001), who looked for evidence of phonological activation of the translation equivalents of words from the response language. The author used a phoneme monitoring task whereby Catalan-Spanish bilinguals were presented with a drawing and a phoneme which either constituted part of the picture's translation in the non-response language, or not, or was not part of the picture's name in the response language. Speakers were asked to identify whether the sound was part of the name of the picture in Catalan (L1). For instance, they would see the picture of a TABLE (*taula* in Catalan) and had to decide whether /m/ (appearing in the Spanish translation equivalent for 'table', *mesa*) and /f/ (not appearing in the Catalan picture name nor in the Spanish counterpart) belonged to the Catalan picture name. The prediction was that if the picture activated both languages' words and the lexical nodes spread their activation to segments of words from both languages, participants would need more time to respond whether a sound

belonged to the name of the picture in the response language. Alternatively, if only features from the response language were activated, there should be no difference between the latencies to the two phonemes. The results supported the former prediction whereby there was a significant difference between the response times for the translation and the control conditions which was interpreted as evidence of activation of the non-response language.

Lee and Williams (2001) used the semantic competitor priming paradigm as an alternative to picture-word interference paradigm to explore the competitive nature of lexical selection in bilinguals. In this study, English-French bilinguals had to respond to a definition of stimuli and name two pictures in a row. Definition presentation and response was always in participants' L1 (English), while picture naming varied so that it could take place in any language combination (only in L1, only in L2, one picture in L1 and the other in L2, and vice versa). For example, a trio of definitions would appear simultaneously on a computer screen to which a single-word response was expected, followed by two pictures for naming. The semantic competitor manipulation concerned priming the target pictures (e.g., *dog* or *chien*; 'dog' in French) with a semantic competitor (e.g., *fox*) vs. an unrelated word (e.g., *snow*) as a response to a definition three trials before the target picture trial. The reasoning was that picture naming in French (L2) would be inhibited by prior production of a semantic English competitor, thus leading to slower response latencies in comparison to an unrelated English prime. Indeed, the findings showed a semantic competitor priming effect within-language, that is, slower picture naming in French (L2) than in English (L1), as well as between-language from English to French (L1-L2). The authors argued that this was evidence for lexical competition, and that strong inhibition of L1 words came into play as a means to regulate production in the response language.

In a more recent study, Costa, Roelstraete, and Hartsuiker (2006) examined whether the lexical bias effect (LBE) attested in monolinguals could also be found in bilinguals. The LBE is the tendency for phonological substitution errors to result in words but not in non-words, and is attributed to feedback between the phonological and lexical levels of representation during speech production (see also Hartsuiker, Corley, & Martensen, 2005, for an additional account). For present purposes, we will focus on Experiment 2 in which the SLIP-task was used (laboratory-induced slips of the tongue) to explore whether phonological activation of lexical representations from the non-response language might

feedback to lexical representations with which it is linked irrespective of the language of response. Spanish-Catalan proficient bilinguals silently read word pairs and at certain trial points a sound would follow word-pair presentation after which participants had to name it aloud. The majority of the materials were in Spanish and in the critical pairs (those followed by the sound) an exchange between the first two sounds either led to Catalan words (e.g., *nip tas* → *tip nas*; 'full nose') or to non-words (e.g., *nil taf* → *til naf*). The results showed that more errors resulted in Catalan words than in non-words. The authors interpreted this as evidence for activation of the lexical representations of the non-response language (Catalan) and of language non-specific feedback from the phonological representations to the lexical representations (see also Costa et al., 2000a, for a similar account for words with phonologically similar translations, i.e., *cognates*).

2.3.2.2 Evidence against Language Interaction Effects

Support for *language specific* lexical selection comes from a different study by Costa et al. (1999). In a series of picture-word interference experiments, Catalan-Spanish speakers were asked to name pictures in their L1 (Expts. 1, 3, 4, 5, 6 & 7) or in either language (Expt. 2), while ignoring word distractors which were cognate or non-cognate picture nouns or picture translations, and semantically related or unrelated to the target nouns. The distractors belonged either to the L1 or the L2. For instance, the picture of a TABLE (*taula* in Catalan) would appear with the following word distractors: *taula*, *mesa* ('table' in Spanish), *pernil* ('ham' in Catalan), and *jamon* ('ham' in Spanish). The authors sought to explore the role of different-language identity distractors (i.e., target words' translations) during lexical selection. They predicted that if the picture activated both languages' lexicons and lexical selection was language non-specific, then *mesa* would interfere more with the target-noun *taula* than with a semantically related distractor, because *mesa* would receive activation both from the picture and the written stimulus *mesa*. On the other hand, if lexical selection was language specific, different-language identity distractors should facilitate the retrieval of the word in the response language because *mesa* through its semantic representation would activate its corresponding word in the response language (i.e., *taula*).

The main findings relevant to the context of this section were the following: (i) different-language identity distractors facilitated picture naming in comparison to distractors that were unrelated words, (ii)

semantic interference was the same for both language distractors pointing to an equal degree of semantic memory implication for highly proficient bilinguals, and (iii) phonologically similar distractors facilitated picture naming regardless of language of origin. Costa and colleagues interpreted these results as evidence for language non-specific flow of activation from semantic representations to lexical representations, but for language-specific lexical selection. The facilitatory effect was accounted for the fact that the picture noun in the response language received activation both from the word's semantic representation and from its translation distractor. Due to the lexical selection mechanism that considers only the activated lexical items of the response language, the word in the intended language was thus produced faster. The semantic interference effect was attributed to competition between a semantically-related word in the response language (activated by the distractor) and the picture noun in the response language. In this sense, interference occurred between semantically related words within the same language lexicon.

In the same line, Costa, Kovacic, Franck, and Caramazza (2003) examined whether gender features of the non-response language may interfere with gender feature processing in the response language. In a series of experiments in which different language pairs were involved (Croatian-Italian, Catalan-Spanish, Italian-French), proficient bilinguals had to name two sets of pictures in their L2 (except Expt. 3 in which mixed-language naming was introduced). Pictures' names in the L2 and their corresponding L1 translation equivalents would either have the same grammatical gender or not. The authors predicted that if the two gender systems are somewhat integrated, the retrieval of the target's gender feature should be faster when that gender was shared between the two languages than when not. Facilitation could be attributed to the fact that in the former case the gender feature in the response language would receive activation both from the word in the response language and its counterpart in the non-response language. On the other hand, if the two gender systems are autonomous no difference should be found in response latencies between same-gender and different-gender translations. The results from all language pairs supported the second prediction whereby naming latencies were not affected by gender convergence or divergence between the target word and its translation equivalent. The authors concluded that the evidence they obtained was in favour of a language specific account of gender retrieval, but left open the question of whether this view could generalize to other aspects of language representation and production either because of conflicting results or because of lack of empirical evidence.

2.3.2 Summary

To summarize, from the reviewed bilingual studies on language interaction effects, the following points are worth noting: (i) the flow of activation from conceptual representations to lexical representations is agreed to be language non-specific since both lexicons of a bilingual have been found to be activated in parallel; (ii) the flow of activation from lexical representations to phonological representations has also been found to be language non-specific whereby phonological properties of the non-response language are also activated; (iii) the issue of lexical selection, however, is not clear yet as there are conflicting results supporting either a language specific or a language non-specific account; (iv) the majority of psycholinguistic studies that have explored language interaction effects have used the picture-word interference paradigm, and (v) the focus of interest in all these studies has been on language segments no larger than a word or word-pair.

However, since the question of whether the non-response language may interfere in the processing of the response language cannot be clearly answered yet using the picture-word interference paradigm, we believe that new attempts to address this question are imperative. In addition, most language outside the laboratory is produced in larger units and in meaningfully richer context. Therefore, it is crucial to investigate language interaction effects at sentential level so as to gain a better understanding of the cognitive mechanisms that underlie bilingual speech processing, with the ultimate aim to integrate experimental evidence about bilingual speech representation and production into a model of bilingual sentence production.

2.4 Code-Switching: Cocktail of Languages

In this section we introduce an interesting, yet challenging bilingual linguistic phenomenon, that of mixed-language production. We will discuss the different forms it takes and approaches and theories of it. More importantly, we will explore how code-switching (CS) is realized in the light of the considerations expressed in the previous section regarding language interaction effects.

2.4.1 Definitions and Origin

Code-switching has been interchangeably used with other terms such as *code mixing*, *language mixing* or *language switching* to describe the alternation of language use in bilingual discourse (e.g., Crystal, 1987). Systematic examination of the spontaneous speech of bilinguals suggests that the grammatical categories of code-switched elements may vary from single nouns, adjectives, adverbs and verbs to whole main or subordinate clauses, prepositional phrases and noun phrases (Lederberg & Morales, 1985). Quantifiers, articles, prespositions, clitics and auxiliaries appear less likely to code-switch (Joshi, 1985), a trend that some linguists take as an indication that code-switching is a patterned phenomenon that follows certain rules (e.g., Sridhar & Sridhar, 1980).

However, it is important to note that to date there has not been proposed any grammar to account for this kind of mixed-language discourse. In an attempt to do so, researchers in the field of CS have proposed a number of rules and constraints, but as we shall see shortly, the presentation of counterexamples questions how generally applicable these constraints can be. Poplack (1987) in a characteristic manner describes the literature on CS as being framed within the "*rule-and-exception*" paradigm, meaning that every rule that is proposed for code-switched speech is accompanied by its exception. What is unquestionable though is that code-switching is a widespread linguistic phenomenon if one considers that approximately half of the world's population use more than one language in their everyday life (Grosjean, 1982). In fact, any acquirer of two or more languages may code-switch (Nortier, 1990) yet complex forms or use of CS is usually displayed by speakers with high competence in both languages (Toribio & Rubin, 1996; Muysken, 2004).

There are many interesting questions about why code-switching tends to occur, and where it is most likely to occur. Regarding the question of origin of CS, sociolinguistic prerequisites for its emergence are mainly the existence of a bilingual or multilingual environment, and the feeling among interlocutors that they share a common background ("shared identity") which allows them to use their languages in a variety of ways and be understood nevertheless (e.g., Gardner-Chloros & Edwards, 2004). It has also been suggested that code-switching is used to serve specific communicative purposes during different interaction situations (Myers-Scotton, 1983; Myers-Scotton, 1998). For instance, a speaker may code-

switch in an attempt to accommodate the participation of all speakers present, to emphasize something, to change topic, and so on. From a psycholinguistic view, CS may also occur when a speaker finds difficulty in retrieving the intended word or expression in the language currently spoken. Thus, in order not to disrupt a conversation, she may make use of a lexical item/expression from the other language her interlocutor also understands and speaks. Moreover, Cook (1989, 1991) has proposed code-switching as a teaching tool for second language acquisition which can be used in the classroom by teachers and students alike.

MacSwan (2005) has expressed the view that CS research should be ideally conducted in young-age simultaneous bilinguals so as to eliminate any influence of other factors on code-switched use and patterns, such as level of proficiency and age of acquisition of the second language, or the possibility that bilinguals learn code-switching constraints by observing other bilinguals who code-switch (but see Toribio, 2001, for an opposing view whereby bilinguals appear to rely on unconscious principles in distinguishing between "allowed" and "disallowed" code-switches). We shall agree with Janice, Myers-Scotton and Gross (2005) that such an idea would not only be difficult to implement, but it would also leave out a great number of CS data yielded by bilingual as well as multilingual speakers. Moreover, we believe that the comparison between a wide variety of code-switched speech produced under different sociolinguistic and psycholinguistic conditions may lead to very interesting observations and to a more informative account of the mechanisms underlying the linguistic phenomenon of code-switching.

Code-switching can take place between sentences (*inter-sentential CS*) (e.g., Pick up the phone! *Ο Γιώργος είναι*[4]; 'Pick up the phone! It's Giorgos', English/Greek) or within sentences (*intra-sentential CS*) (e.g., Wan ik komt *home from school*; 'When I come home from school', English/Dutch: quoted in Clyne, 1987). Intra-sentential code-switching tends to occur at points where the surface structure of the two languages maps onto each other, that is, at sites where word order is similar (*Equivalence Constraint*) (Poplack, 1978, 1990). However, there are a number of counterexamples, often involving typologically distant languages such as Arabic-French, Irish-English, Swahili-English, Japanese-English, and German-English, showing that the Equivalence Constraint cannot be regarded as a universal

[4] Language alternation is indicated by the use of italics, as is conventional in CS literature.

constraint on intra-sentential CS (Bentahila & Davies, 1983; Stenson, 1990; Myers-Scotton, 1993; Nishimura, 1995; Eppler, 1999). For example, a possessive pronoun in English typically precedes a noun, unlike Arabic in which the reverse order is used. Thus, according to the *equivalence constraint*, there cannot be a switch between a possessive pronoun and a noun in this language-pair. However, Mustafawi (2002) reports counterexamples (e.g., axalli il*vacation* mali hag *next year*; 'I'm saving my vacation for next year', Arabic/English) in which the speaker code-switches between a possessive pronoun (*mali*; 'my') and a noun (*vacation*).

As we shall see in section 2.4.2 *Approaches, Theories, and Models of Code-Switching*, certain assumptions have been made about intra-sentential CS in an attempt to describe it within the realm of a universal or language-specific grammar which is constrained by syntactic and morphosyntactic rules. This is also evident from a number of constraints that have been proposed in code-switching literature to specify sites that can be regarded as permissible for switching. For instance, DiSciullo, Muysken and Singh (1986) have proposed the *Government Constraint* whereby "*the lexical governor and the highest lexical element of the governed maximal projection need to be in the same language*". This means, for example, that a verb or preposition must be in the language of its complement, and that there cannot be switching between an auxiliary and verb, nor between a pronominal subject and verb (Timm, 1975, but see Savic, 1994; Belazi, Rubin, & Toribio, 1994, for contradictory data, Halmari, 1997, for a modification of the *Government Constraint*, and Muysken, 2000, for further cricitism). Mahootian and Santorini (1996) have proposed the *Head Constraint* according to which the language of a head determines the syntactic properties of its complements in CS just as in a monolingual context, and Gumperz (1976/1982) has suggested that conjuctions must be in the same language as the following clause. More importantly, and for the purpose of our study, an often quoted switch site is after a noun phrase (NP) (e.g., MacSwan, 2000; Callahan, 2002) as illustrated in the following examples: El perro *chewed him up*; 'The dog chewed him up', Spanish/English: quoted in Pfaff, 1979; Móvo *préventive medicine* χωράει σ' αυτά; 'Only preventive medicine is left', Greek/French: quoted in Androulakis, 1994. In the thesis, we focus our attention to this latter occurrence of code-switching as it is a common switch site for the two languages we examine whereby English and Greek structures map onto each other.

2.4.2 Approaches, Theories, and Models of Code-Switching

Code-switching, particularly inter-sentential CS, has been predominantly studied from a sociolinguistic perspective and the main tool that has been used to examine CS data is that of conversation analysis (Auer, 1998). Other approaches, mainly linguistic ones, have been developed only during the last two decades and have focused on research in intra-sentential CS (e.g., MacSwan, 2004), while psycholinguistic aspects of CS have been barely addressed (Treffers-Daller, 1998). It is important to note that the variety of CS reported data is so wide that so far has not allowed for the formulation of a prescriptive grammar of CS. Thus, most linguistic views are based on the grammatical properties that govern each language system as well as Universal Grammar (MacSwan, 2005). In other words, linguistic accounts of code-switching differ with respect to whether people simply implement the grammar of the language they speak at the time or whether there is an *amalgam* (integration) of linguistic elements of the two languages present.

Regarding the former account and in generative terms, Woolford (1983) argues that code-switched speech is meaningful because speakers apply the linguistic rules of each of their languages to the appropriate language segment. We assume that this can be true, yet not always verifiable. That is, it is not always obvious which language is being used at a given point. For instance, in cases where both language structures overlap at a particular switch site, it is difficult to distinguish which language is the one that has provided its structure. The same author also claims that there is no interaction between the two grammar systems during code-switched production. Boeschoten (1991), on the other hand, demonstrates that there are a great number of examples in code-switching literature which show that the contact of two languages is not a mere juxtaposition of two separate linguistic realizations. On the contrary, he views code-switching as a creative and sometimes innovative procedure whereby linguistic elements and syntactic structures from both languages can be conbined in such a way that cannot be explained by monolingual grammar or a given CS constraint. In the same line, Poplack (1987) argues that there is not strong evidence to suggest that code-switching can be explained based on the same formal theories of grammar that may account for monolingual speech, and she adds that monolingual resources can be adapted in many different ways in code-switched speech. Myers-Scotton and Jake (2001) also agree that CS structures are evidence of different language material combination and variability.

An example of code-switched creativity is the following utterance that was yielded in a written communication between two Greek-English fluent bilinguals living in the United Kingdom: Υπάρχουν πολλά και *obvious extensions* στα *studies* που έχεις ήδη κάνει. Το πιο προφανές είναι να *replicate* με διαφορετικά *materials*; 'There are many and obvious extensions to the studies you have already done. The most obvious one would be to replicate with different materials'. It is worth noting, that the speaker switches at sites which are common for both languages, that is, the English segments can be translated straight into Greek and vice versa. However, he violates some of the constraints we presented in the previous section as he switches between a preposition and a noun (στα *studies*), between an auxiliary and a verb (είναι να *replicate*), and between a conjunction and a clause (και *obvious extensions*…).

We have mentioned that through observation of transcribed corpora of either natural or elicited code-switched conversations as well as grammaticality judgements, scholars have proposed a number of rules and constraints in an attempt to standardise code-switched production and accentuate its similarities to single-language production. For instance, the *Free Morpheme Constraint* states that it is not allowed to switch between a bound morpheme and a lexical item unless the latter has been phonologically integrated into the language of the bound morpheme (Sankoff & Poplack, 1981). Thus, an expression such as Sobral sebe ogromnuju kolleksuju vorovannyx *piece*ov *of art* (literally 'He collected a huge collection of stolen pieces of art for himself', Russian/English) should be considered disallowed and ungrammatical according to the *Free Morpheme Constraint* because "ov" is a masculine plural bound morpheme which denotes possession and cannot combine with a lexical item from another language. It is a paradox though, that this very expression and other counterexamples that "violate" constraints such as the one mentioned above are end products of natural occurring speech (Muysken, 2000). How can a linguistic phenomenon then be disallowed when it occurs in the natural course of speech production?

We believe that theories of code-switched production should primarily take into account and be built upon tendencies of "real" language formations; that is, upon speakers' natural language exchanges in everyday speech and in language production tasks as such, and not upon stringent grammar rules considered out of context or inferred from monolingual grammar (Poplack, 1987). In addition, Belazi et al. (1994) claim that some constraints appear contradictory because they are formulated upon data that have been collected through diverse collection methods, or upon data that have been used selectively

which allow for generalization of those rules. Therefore, we argue that there is not a solid foundation to justify characterizations such as *disallowed* or *ungrammatical* attributed to CS, especially that of intra-sentential CS. Moreover, we claim that any proposed constraints should allow for deviations since language use may vary from one linguistic environment to another as well as among the speakers of the same linguistic environment (Romaine, 1995; Mahootian & Santorini, 1996; Sebba, 1998). In this thesis, we use instead the terms *tendency* and *pattern* to describe language feature manifestations in code-switched utterances (see also Mahootian, 1993, for a similar view).

Apart from constraints and principles, certain models have been proposed to explain language processing during code-switching, yet no general consensus has been reached as to the workings of code-switched production. MacSwan's (2000, 2004) model of CS, for example, is based on Chomsky's (1995) linguistic theory of Minimalism within which grammar is reduced to its minimal essentials. That is, language computations are assumed to be produced in the most *economical* manner. According to this approach to code-switching, language operations are directed by two central components: a computational system which is language non-specific and two lexicons (one for each language) where rules of word formation and other idiosyncratic differences across languages such as functional categories and their feature values are stored. A phrase structure is built through a series of linguistic operations and movements deriving from each lexicon which are subject to checking mechanisms. That is, lexical items which are selected from the lexicon (via the operation *Select*) pass through a stage where derivation construction takes place (*Numeration*), to be next hierarchically arranged syntactically (*Merge*). An important condition for the formation of a new phrase structure tree is that lexically encoded features (e.g., case, number, person, and gender) match in the course of a derivation (*Move*). This can be achieved through a feature checking mechanism. Once derivations are checked for convergence at the interface of the syntax with lexical features (*Logical Form*; *LF*) they can reach the surface structure (*Phonetic Form*; *PF*). If checking fails, then the derivation crashes which in the case of code-switching means that the utterance is considered ill-formed.

The most comprehensive and often cited model of intra-sentential code-switching that has adopted a Universal Grammar approach, is the Matrix Language Frame model (MLF) proposed by Myers-Scotton (1993). Its basic assumption lies onto the claim that when two or more languages come into contact in a

code-switched situation, one language sets the morphosyntactic framework and the other may then insert its linguistic elements (Callahan, 2002). The former is called the *Matrix Language* (ML), or else, base-language or host-language, and the latter the *Embedded Language* (EL), or guest-language. Certain sociolinguistic and structural factors have been proposed to define when a language would be considered a ML and when an EL. In sociolinguistic terms, the language that speakers are more proficient in, that is, the language that is expected to be the one most in use in an environment where two languages are spoken, is assumed to be the ML that would host the EL (Myers-Scotton, 1993; Myers-Scotton, 1995). In structural terms, ML is the one that occupies more space in an exchange of utterances by providing the highest number of linguistic elements in comparison to EL. Thus, it becomes obvious that the balance between a matrix and an embedded role is not constant and may change depending on communicative situations and speakers' intentions.

It has also been proposed that the beginning of a sentence (if it belongs to the speaker's dominant language) could take the role of a ML, but the claim that the main verb of a clause signifies the ML seems to be more widely accepted (Muysken, 1995). In addition, Myers-Scotton (1993) argues that code-switched utterances should extend beyond a single sentence's boundaries in order to be able to distinguish between a ML and an EL, especially in code-switched utterances in which word order is the same between two languages. In other words, a study of a text involving CS would be more informative as to the role of ML and EL than a study of a single sentence. However, there have been counter-suggestions that such a distinction is plausible even in short sentences, if the contextual environment of a conversation (e.g., who is talking to whom about what) is taken into consideration (Poplack & Meechan, 1995). In this light and in psycholinguistic terms then, this might imply that the most activated language in a discourse should be considered the ML (Muysken, 2000).

Following the structure of Levelt's (1989) model of monolingual speech production that we briefly presented earlier on, Myers-Scotton and Jake (2001) distinguish four levels of language representation in code-switching; the *conceptual level*, the *lemma level*, the *functional level*, and the *positional level*. At conceptual level bilinguals decide the message they wish to communicate to their interlocutors as well as the mode (monolingual or bilingual) to be used. These decisions lead to activation of lemmas from the appropriate language mental lexicon. The predicate/argument structure maps lexical items to their

syntactic role in a message, and grammatical relations as well as syntactic dependencies like agreement and word order are defined at morphological realization level and are better integrated at functional level. At the positional level the intended utterance takes its final phonetic surface-form.

Moreover, the role of two categories of morphemes that participate in CS, namely *content* and *system* morphemes is of crucial importance for MLF. According to the *System Morpheme Principle*, closed-class items (*system morphemes*) belong to ML, unless they are part of a well-formed EL formation, and open-class items (*content morphemes*) may come either from the ML or the EL. System morphemes of EL are expected to be followed by EL elements. Content morphemes assign and receive thematic roles and are activated at the lemma level. System morphemes are distinguished into *early* and *late* system morphemes. The former (e.g., determiners, plural-*s*, and prepositions) are assumed to be activated at the lemma level and contribute to the mapping of the conceptual structure to the lemma. The latter are called by the grammar rather than speakers' intentions, and are further distinguished into *late bridge system morphemes* (e.g., possessive markers), which are only activated at the formulator level and their role is to integrate content morphemes into a larger constituent, and into *late outsider system morphemes* (e.g., 3rd person singular) which are structurally assigned at positional level (Myers-Scotton & Jake, 2001).

2.4.3 Varieties of Code-Switching

Prior to presenting a number of code-switched manifestations, we consider it important to make a distinction between code-switching and *borrowing* (loan). Although the latter often appears in language-contact studies, it is generally not considered a kind of code-switching since it usually refers to a single-word (most likely a noun) that is fully assimilated in a language other than its origin (e.g., Sankoff, Poplack, & Vanniarajan, 1990; Poplack & Meechan, 1998). In addition, borrowing may be used by monolingual and bilingual speakers alike, whereas code-switching is strongly considered a manifestation of bilingual competence (Pfaff, 1979).

The way linguistic elements from both languages may combine in intra-sentential CS is distinguished into three categories: *alternation*, *insertion*, and *congruent lexicalization*. A*lternation* means the mixing of languages at sentence or clause boundaries, where the bundle of constituents of each one of them

would be properly grammatical and meaningful if considered in isolation (Muysken, 2000; Backus, 2003). *Insertion* describes the phenomenon where content words, usually single constituents, from EL are imported in ML framework (Bernardini & Schlyter, 2004), and *congruent lexicalization* allows the mixing of lexical items from both languages at sites in a sentence where the syntactic structure is shared between the languages that participate in code-switching (Muysken, 2000). According to MLF, there may be instances where ML and EL content morphemes are mixed together in a grammatical framework set by ML, or instances where constituents that belong only to one language (either ML or EL) may be put together, creating the so-called *islands*. (Further information on the occurrence of islands will be provided in the next section). We should also note that because of the features of reduction and simplification (e.g., bare forms and omission of clitics) that are observed in *congruent lexicalization*, the latter has been assumed to be closely related to *convergence* as we shall see shortly.

2.4.4 The Notion of Convergence in Code-Switching

Another notion that is relevant to bilingual and code-switched speech (and to our study) is that of *convergence*, which has been used to describe that kind of language behaviour whereby structural properties between two language systems may change in order to display a uniform character (Bullock & Toribio, 2004). The direction of change may be bidirectional but it usually moves from the L2 to become more like the L1 (Montrul, 2004). Language change of this kind can emerge at any level of language representation, but it is particularly attested at the interface of syntax and semantics, especially at times when both languages participate in a discourse (e.g., Ella no estaba *accustomed to that kind of work*; 'She was not accustomed to that kind of work', Spanish/English: excerpt quoted in Toribio, 2004). In the preceding example, the overt personal subject pronoun is discourse-pragmatically non-target-like, that is, a monolingual Spanish speaker would omit it, unlike an English speaker. However, concurrent activation of the English language is assumed to influence the pronoun's function resulting in its overt encoding.

With regard to occurrences of utterances displaying convergence it has been suggested that these may occur as a means of reducing processing costs (Muysken, 2002), although a view that relates convergence to *attrition*, that is, to gradual loss of the L1, has also been expressed (Cook, 1989). Convergence manifestation in code-switching is rather a short-term effect, and it is mainly dictated by

sociolinguistic factors, especially by interlocutors' communicative intentions (Hinskens, Auer, & Kerswill, 2005). Thus, a bilingual who wishes to express closeness to her conversational partner may linguistically adapt her speech to that of her interlocutor's by accommodating to her linguistic choices or by adopting similar linguistic patterns (Trudgill, 1986).

From the Matrix Language Frame model perspective, convergence may emerge when there is incongruence between the features of two languages at abstract or at surface level, or when there is some sort of competition between the languages. Thus, although Myers-Scotton (2002) admits that "*congruence*" has not yet been given a precise definition, she argues that when there is "insufficient congruence", production resolves either in favour of the ML or resorts to compromise structures (but see MacSwan, 1999, for an opposing view). Such structures are usually well-formed Embedded Language constituents (*Embedded Language islands*; *EL islands*) (e.g., No van a *bring it up*; 'They are not going to bring it up', Spanish/English: quoted in Myers-Scotton & Jake, 1995), or Embedded Language content morphemes which lack expected Matrix Language grammatical properties (bare form; Ø inflection) (e.g., Hoiti si-tä *olive farm*-Ø; literally 'He took care of the olive farm', Finnish/English: quoted in Myers-Scotton, 2002, in which *olive farm* lacks the case marking -*a*).

Importantly, for the issues we raised in section 2.3.1 *Word Selection and Language Control*, we need to draw attention to MLF's assumption regarding language selection and control in code-switched structures displaying convergence. We mentioned above that competition between the contrasting feautures of two languages may lead to structures that display syntactic convergence such as *EL islands*. For example, a bilingual may be able to express an idea in two different ways depending on how a verb argument is constructed in each of her languages. If the speaker decides to code-switch at a point where a verb should be produced, there might be competition between the two activated verb-structures. According to the Matrix Language Frame model, in case the verb of the language the bilingual prefers to use belongs to the EL, the only way that verb may win the competition is by being produced in an EL island, because that is the only way verb-argument can be fully formed in the EL (Myers-Scotton, & Jake, 2001). This entails that the activation of EL will have to be higher than the activation of ML to prevent structure formations from the latter. In this light, the Matrix Language Frame model adopts an

inhibitory perspective (e.g., Green, 1986) to account for language selection in structures displaying syntactic convergence.

2.4 Summary

By presenting information on mixed-language use, especially on intra-sentential CS formation and the views that have been expressed about it, we believe we have made clear why this linguistic phenomenon poses a challenge for models of bilingual speech production. The lack of a prescriptive grammar of CS and the wide variation in CS patterns, as reported in naturalistic data and corpora, have led to controversial interpretations and assumptions of what is "right" or "wrong" in CS. This in itself is an issue that necessitates further research that will provide CS field with well-grounded theories and assumptions. Nevertheless, code-switching is undoubtedly a widespread act of speech among proficient bilinguals and multilinguals and may occur at any level of language production. The issue of how speakers of two languages may combine creatively, yet meaningfully, properties from both language systems will be further considered in the thesis with special emphasis on *number agreement*. Of particular interest, and for the purposes of our study, are the effects of interaction of mismatched features on agreement in single-language production and on agreement in code-switching. Moreover, we are interested in the effects of CS on single-language speech when the former is produced in the same session as the latter. In the following section we provide an in-depth presentation of the construction of agreement in monolinguals and bilinguals.

2.5 Subject-Verb Agreement Construction

In this section we introduce another grammatical aspect of speech production which constitutes part of our research, that is, verb-argument agreement; in particular, subject-verb *number* agreement. (Pronoun-agreement will be discussed in the corresponding experimental chapter; *Chapter 5*). At this point we need to distinguish between the relevant terms that will often come up in the thesis. *Notional, conceptual, or semantic number* is the inferred number of an intended referent. *Grammatical number is* related to the linguistic agreement properties of a word, that is, the number that has been given to a word in prescriptive grammar books. *Morphological number* usually refers to the number specified by the

morpheme that indicates a singular or a plural inflection. For example, the noun *trousers* is notionally singular in English because it is considered a singleton (Bock, Eberhard, Cutting, Meyer, & Schriefers, 2001), grammatically plural because it takes a plural verb (*Collins Cobuild English Grammar*, 1994:15), and morphologically plural because it bears a plural *-s* inflection.

Next, we present what is assumed about the systematic covariation of linguistic forms in monolingual speech production and discuss a number of studies that have addressed important relevant issues. We then attempt to move towards a bilingual account of S-V agreement in which factors such as mode of speech and language interaction raised in previous sections of the literature review are also considered. As we shall argue, language interaction may have important implications for the representation of semantics, morphology, syntax, and discourse during agreement construction in bilinguals.

2.5.1 The Monolingual Case

English grammar states that when the subject is morphologically singular, the verb is also singular and when the subject is morphologically plural the verb is also plural (e.g., Curme, 1931). According to Corbett (1983, 1998) there are two kinds of agreement. In *syntactic* or *grammatical agreement*, the grammatical properties of the *controller* (element agreed with) set the properties that the *target* (agreeing element) must conform with. In *semantic* or *notional agreement*, the conceptual properties of the controller (rather than its form) exert their effect on the target. Thus, a sentence such as *The trees are tall* involves syntactic number agreement because the verb agrees with the morphological plural number of the subject noun. In contrast, *Brazil are through to the next phase* (quoted in a match description produced by a TV commentator during FIFA world cup 2006) involves semantic agreement because the verb agrees with the notional plural number of the subject noun and not with its singular morphology. That is, the verb is put in plural because it agrees with the number of entities of the referent which in this case are the players of the team of Brazil. (Figure 2 shows the representation of the dual-component (i.e., semantically plural – syntactically singular) of a lexical item).

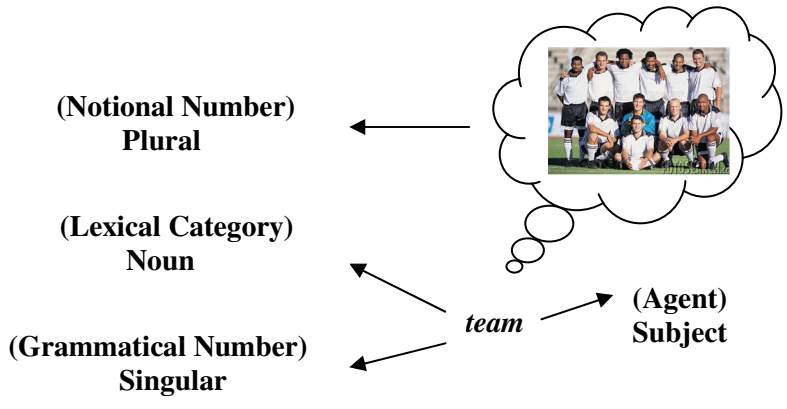

Figure 2. Representation of the dual-component (semantic/syntactic) of a lexical entry in language processing.

This distinction accords with accounts of production that assume separate syntactic and semantic components to lexical entries, such as Levelt et al. (1999). People have to decide on a meaning that they wish to describe and select a word that fits that meaning. They have to access that word's grammatical properties (as well as its sound). During subject-verb agreement construction, that is, at the stage of *grammatical encoding* (Bock & Levelt, 1994), a head noun is selected for a noun phrase (NP). This operation comprises processes such as selection of that noun's grammatical features and function assignment of the noun. What follows next is selection of the predicate and retrieval of its grammatical features. In semantic agreement, properties of the word's semantic component (or *concept*) exert their influence on the verb. In syntactic agreement, properties of the word's syntactic component (or *lemma*) exert their influence instead. The difference between semantic and syntactic agreement therefore amounts to a distinction between concept-based and lemma-based influences on production.

With respect to the above distinction, two accounts have been proposed to describe subject-verb agreement construction. According to the *feature copying* view, the verb acquires its feature specification from the grammatical number of the subject which entails that such an operation does not allow for conceptual effects on agreement (e.g., Chomsky, 1965; Kempen & Hoenkamp, 1987). Thus, the hierarchical ordering of relation between subject and verb appears to be very important as the latter is dependent on the former for its feature acquisition. In this sense, the feature copying view is compatible with the minimalist approach since agreement is not under direct control from message-level structures (e.g., Garrett, 2000). On the other hand, the *feature merging* account assumes that information from the

participating linguistic elements is computed so as to be represented in a tree structure where the set of features is compatible with both elements (the NP and the verb) (e.g., Pollard & Sag, 1988; Kempen & Vosse, 1989). The checking mechanism that ensures that a target and its controller bear the same number is called *unification*. This view allows for conceptual effects since agreement feature retrieval from the conceptual representation is independent for the NP and the verb (Vigliocco, Butterworth, & Garrett, 1996a).

As we shall see shortly, competition between syntactic and semantic agreement may arise especially when there is a mismatch between the semantic and morphological properties of the head noun which is relevant to the objective of our research. Prior to discussing these studies, let us summarize the main findings of monolingual literature which show that factors such as the following may influence number agreement: (i) difference between the morphological number of the head noun and the morphological number of the closest-to-the-verb noun (*local noun*) (Bock & Miller, 1991; Haskell & MacDonald, 2003); (ii) mismatch between the morphological number and the notional number of local nouns and head nouns with some languages being more prone to be influenced by morphological variables (Bock et al., 2001) and others by semantic variables (Vigliocco et al., 1995; Vigliocco et al., 1996a; Vigliocco, Hartsuiker, Jarema, & Kolk, 1996b), and (iiii) distance between the local noun and the verb of the same clause (*proximity concord - attraction*) (Quirk, Greenbaum, Leech, & Svartvik, 1972; Fayol, Largy, & Lemaire, 1994; Kaan, 2002; Franck et al., 2004) or between a mismatching feature embedded in a prepositional phrase and the subject head noun (e.g., Franck, Vigliocco, & Nicol, 2002). For present purposes, in what follows we discuss a number of studies that have explored the effects of semantics and/or morphology of the head noun on the probability of correct/erroneous S-V agreement.

2.5.1.1 Semantic vs. Syntactic Influences on Verb-Agreement

Psycholinguistic evidence showing that agreement does not come entirely from a syntactic source comes from studies in which the notional properties of head nouns are manipulated by creating noun phrases with single as well as distributive readings (e.g., *The bridge to the islands* vs. *The label on the bottles*). The contrast manipulated in noun phrases like these is that a singular head noun can refer to multiple entities when it forms part of a complex noun phrase. That is, although *label* appears

syntactically and semantically singular, it typically refers to more than one entity in the above-mentioned phrase, because a different label is likely to be on each bottle. When this happens, speakers show a tendency to use a plural verb in comparison to otherwise similar phrases like *The bridge to the islands*, in which only one *bridge* can be taken to lead to the islands. Although Bock and Miller (1991) found no effect of the notional feature of *distributivity* on the elicitation of errors, more recent studies have found distributivity effects of the head noun on verb-agreement not only in English, but also in other languages as we shall see shortly.

In an Italian study, Vigliocco et al. (1995) examined whether verb-agreement reflects a mere process of syntactic feature copying from the subject, as it was assumed by Bock and Miller (1991), or whether the factor of language (inflectionally rich vs. inflectionally poor) could be a predictor of semantic susceptibility in S-V agreement computation. In a series of experiments the authors manipulated the number of the subject nouns so that single and distributive readings were created as well as the number between the subject and the local noun in predicate adjective phrases. That is, participants would see a phrase such as *La strada verso i laghi* ('The road to the lakes' in Italian) or *L'etichetta sulle bottiglie* ('The label on the bottles' in Italian) followed by an adjective (marked for singular or plural), for example, *pericolosa/e* ('dangerous' in Italian, fem. sg/pl), or *storta/e* ('crooked' in Italian, fem. sg/pl) which they had to use to make a full sentence. The results showed that Italian speakers were sensitive to distributive readings, and thus, to the role of semantics. This led them to override grammatical information about singularity and yield more errors in the distributive readings than in the single readings. In addition, more errors of semantic agreement were made when a singular head noun was followed by a plural local noun than vice versa. (We discuss this finding in more detail further on).

Likewise, in a Spanish study with slightly different materials, Vigliocco et al. (1996a) replicated the results of a previous study with Italian speakers (see previous paragraph, Vigliocco et al., 1995). Namely, more agreement errors were produced in multiple token readings than in single token readings (e.g., *The label on the bottles* vs. *The road to the lakes*), as well as in singular head noun preambles than in plural head noun preambles (e.g., *The uncle of the children* vs *The uncles of the children*) (Expts. 1 & 2). In addition, they replicated Bock and Miller's (1991) results whereby English speakers were not sensitive to the notional number of the NP, not even when inversion between the subject and the verb was introduced

in question formulations (Expts. 3 & 4). The reasoning was that if the verb was retrieved first, then the verb and the NP would independently retrieve agreement features from the conceptual representation which might lead to semantic agreement errors. The authors attributed the absence of distributivity effects for English speakers to cross-linguistic variability between English and Spanish, or other Romance languages, mainly, structural differences (e.g., retrieval of the referent from the perceptual or discourse context in pro-drop languages, strict vs. loose word order, poor vs. rich inflectional system) (see also Nicol, Teller, & Greth, 2001, for a similar view). According to Vigliocco and colleagues these factors might play an important role in how these languages are affected by conceptual factors during grammatical encoding because the verb most often acquires its number specification from the conceptual representation of a hypothetical subject phrase. This is assumed even in the case where the subject is present (but see Hartsuiker et al., 1996).

The above considerations were addressed directly in another study by Vigliocco et al. (1996b), this time with Dutch (Expts. 1 & 2) and French (Expt. 3) monolinguals. The authors used these two languages because in some aspects they shared some features with the languages previously studied (English, Italian, and Spanish). That is, English, Dutch, and French, unlike Italian and Spanish, require the subject noun to be overtly expressed in an utterance. This entails that in languages in which the subject may be dropped (pro-drop languages), the verb must retrieve its number specification from a referent in the perceptual or discourse context. Therefore, if this variable played a role in how sensitive S-V agreement was to conceptual effects, similar results were expected from the former group of languages. If language word order had an effect (post-verbal subjects), that is, if again the verb had to acquire its number from the discourse model, French should behave like English, whereas if verb number marking had an effect, Dutch and French were predicted to behave like Italian and Spanish (see Franck, Lassi, Frauenfelder, & Rizzi, 2006, for a theoretical syntax approach to inversion constructions in S-V agreement).

The experimenters manipulated the number of subject and local nouns, creating single and distributive readings, and asked their participants to read aloud the NPs which appeared on a computer screen (e.g., *De datum op de munten*; 'The date on the coins' in Dutch) and make full sentences (e.g., *De datum op de munten was oud*; 'The date on the coins was old' in Dutch). The results showed a

distributivity effect for both Dutch and French, thus ruling out the possibility that the presence or absence of the subject in a language determines independent retrieval of number features from the conceptual representation for the subject and the verb, and the possibility that word order has an effect. The authors concluded that difference in richness of verbal morphology between the studied languages and English could be a reason why English speakers tend to copy the grammatical number information from the subject to the verb since verbal morphology in English is not "meaningful" (but see Berg, 1998). That is, in English, verb inflection rarely carries number or other feature information (except in present tense 3rd person singular) therefore the verb most often acquires its number from its controller (subject) out of necessity.

In her study, Eberhard (1999) attempted to disambiguate the findings from previous studies showing English to be insensitive to distributivity during S-V agreement. The author manipulated the presentation of the experimental stimuli whereby the to-be-completed NPs were accompanied with pictures of their referents (Expt. 1), or without any pictures (Expts. 2 & 3). The reasoning was that the presence of pictures would render the conceptual number of the NP clearer, thus enhancing the production of plural agreement errors. The author compared speakers' agreement performance between Experiment 1 and Experiment 2 to see the effect of use of pictures in the former case and absence in the latter case on verb-computation. In Experiment 3, the original materials of Bock and Miller (1991) were used. The results from the first two experiments showed the well-established distributivity effect (regardless of use or absence of picture presentation) whereby more agreement errors occurred in the distributive-referent condition than in the single-referent condition (e.g., *The picture on the postcards* vs. *The check from the stockbrokers*). The third experiment replicated the results of Bock and Miller (1991) and Vigliocco et al. (1996a) of English speakers' "resistance" to NP conceptual influences. Eberhard (1999) argued that one possible reason for the discrepancy between the first two experiments and the third one, as well as between the first two experiments of this study and the relevant experiments of previous studies, was the use in this study of more imageable phrases which might have enhanced conceptual accessibility over grammatical information, thus influencing verb-agreement in the direction of the former.

Further studies have provided evidence for semantic influences on the head noun. Bock, Nicol, and Cutting (1999) examined the effects of collective head nouns on verb and pronoun agreement. (The results for pronouns will be discussed in section *5.2.1 Semantic vs. Syntactic Influences on Pronoun-agreement*). These authors used the sentence-elicitation paradigm of Bock and Miller (1991) and constructed noun phrases which had either a grammatically/notionally singular subject noun (e.g., *The actor in the soap opera*), a grammatically/notionally plural subject noun (e.g., *actors*), or a grammatically singular but notionally plural subject noun (e.g., *cast*). Participants were instructed to complete each noun phrase by making a full sentence. Bock et al. (1999) predicted that if verb implementation was sensitive to the semantic number of the head noun, then in the case of collectives the verb should bear a plural marker since these nouns are considered plural entities. Alternatively, if the verb reflected the grammatical number of the head noun, then it should be marked as singular. The findings supported the first prediction whereby verbs were found to be more sensitive to the notional than the grammatical number of their collective-controllers.

In a more recent study, Humphreys and Bock (2005) manipulated the ambiguity of collective nouns (as units vs. as multiple entities) by changing the preposition in a modifier. In this way, they could create plural (distributed) and singular (collective) construals, respectively, as illustrated in the examples *The gang on the motorcycles* vs. *The gang near the motorcycles*. The reasoning was that *spatial separation* (former example) would enhance distributive reading, whereas *spatial collection* (latter example) would enhance singular reading, and the question of interest was whether verb-agreement would be influenced by the notional number of the NP or not. The authors also manipulated the modality of stimuli presentation (visual vs. oral). The results showed the following effects: (i) collective heads were less likely than distributive heads to induce plural verb-agreement, (ii) after collective heads, plural local nouns were more likely than singular local nouns to pass their number to the verb, and (iii) difference in modality of stimuli presentation did not have a noticeable effect in agreement error occurrence. Based on these findings, the authors concluded that, apart from other languages, the notional number of a subject noun phrase (here, distributivity) appears to exert influence on verb-agreement in English as well.

2.5.1.1 Summary

The findings from the studies that have looked at semantic vs. syntactic influences on subject-verb agreement with nouns can be summarized as follows. *Distributivity*, that is, the notion of individual entities of a collection having the same single-referent, has been found to affect verb-agreement in speakers across languages. However, the results from studies with English speakers are not yet as clear as those of speakers of other Germanic or Romance languages. The main argument that has found support and could account for that difference is the poor English verbal morphology which drives its speakers to rely more on the syntactic features of a subject noun than its semantics. Another conceptual factor, *collectivity* (when a noun can be considered as a unit or as a collection of many entities), has also showed to have an impact on grammatical encoding. In particular, plural interpretation of collective nouns has been observed to be more enhanced when the collective noun is in the position of a subject noun, or in NPs in which a collective head noun is combined with a grammatically plural local noun. (Studies of the effects of the morphological/notional number of particular categories of nouns such as *bipartite* and *mass nouns* on agreement will be discussed in detail in sections 2.5.1.3 and 2.5.2.1 as well as in the experimental chapters of the thesis). Finally, so far, we have gained a first taste of the effects of grammatical mismatch between a singular head noun and a plural local noun that tends to lead to plural agreement errors. Next, we deal with this very finding in more depth and present certain accounts that have been put forward to explain its occurrence.

2.5.1.2 Attraction, Markedness and S-V Agreement

Apart from effects of the syntax and semantics of the subject noun, much evidence suggests that agreement can be affected by the number of the local noun in a complex NP as in the example *The bridge to the islands were crowded*, as reported in English (e.g., Bock & Cutting, 1992; Solomon & Pearmutter, 2004), and in other languages such as French, Italian, Spanish, and Dutch, both in oral and in written speech (e.g., Fayol et al., 1994; Vigliocco et al., 1995). In these cases, the number of the verb seems to be "attracted" to the number of the immediate preceding noun which mismatches the number of the head noun. Three views have been expressed to account for the occurrence of this kind of agreement errors. The *linear distance hypothesis* supports that these errors occur because in this case the verb tends to

agree with its closest noun (Quirk et al., 1972). The *clause packaging hypothesis* assumes that attraction errors may arise because of the competition between the elements of a clause that share similar structural properties (Bock & Cutting, 1992). That is, assuming that encoding for the local noun, the head noun, and the verb takes place at the same time since they all constitute part of the same clause, there are more chances of the local noun influencing verb-agreement if it shares certain features with the head noun. Finally, the *syntactic distance hypothesis* attributes these errors to the high level position of the local noun in the hierarchical structure (at the functional level) which may influence verb-agreement (Franck et al., 2002). In the next three paragraphs we summarize evidence in support of each one of these hypotheses.

Support for the *linear distance hypothesis* and for reliance on proximity criteria in the presence or absence of a dual-task during verb-agreement comes from the study of Fayol et al. (1994). French participants were required to write down orally given sentences (within which the number of the head noun and the local noun was manipulated), while either click-counting (Experiment 2) or remembering a series of words (Experiments 1 and 3). The results showed that more agreement errors occurred in the dual-task conditions and when the head noun was singular and the local noun plural (e.g., **Le chien des voisins arrivent*; literally 'The neighbours' dog are coming' in French). That is, in the case of mismatched number features within the NP between a head noun and a local noun, the written verb tended to agree with the nearest noun. The authors argued that when the agreement checking mechanism lacks cognitive resources, it tends to retrieve a number specification for the verb from the nearest plausible source.

Bock and Cutting (1992), on the other hand, emphasized the importance of the organisation of production units during agreement computation (*clause packaging hypothesis*). In their study, the authors created number mismatched conditions between head nouns and local nouns and contrasted S-V agreement performance after complex prepositional phrases (e.g., *The advisor for the chemistry students*) with S-V agreement performance after complex relative-clause postmodifiers (e.g., *The advisor who directed the students*), or complement-clause postmodifiers (e.g., *The report that they controlled the fires*). The results showed that more agreement errors were produced in singular head-noun – plural local-noun conditions than vice versa, and after phrasal postmodifiers than clausal postmodifiers. With

respect to the former effect, the authors argued that the default singular number of a verb form can be easily overridden by a plural which is semantically and morphologically more complex. For the latter effect, it was assumed that during S-V agreement the information that is provided in each clause is hierarchically integrated into a processing structure (encoding unit), thus creating somewhat insulation from information provided in another clause, and fewer potential sources of interference (*hierarchical hypothesis*). In contrast, phrasal interruptions that carry more information in a single processing structure, that is, the head noun, the local noun and the verb are in the same clause, may easily allow for interference between concurrent features.

Franck et al. (2002) provided new evidence on S-V agreement process (see also Vigliocco & Nicol, 1998) and proposed the *syntactic distance* account that could accommodate previous findings of speakers' differential agreement performance between clauses and phrases. In two experiments, French and English speakers respectively were asked to repeat and complete preambles such as *The computer with the program of the experiments* vs. *The computer with the programs of the experiment*. According to the *linear distance hypothesis* and the *clause packaging hypothesis* that we presented in the preceding paragraphs, the following results would be predicted: following the linear distance account, more agreement errors should be yielded when the local noun mismatched in number with the head noun (regardless of the number of the intermediate noun) than when not. In contrast, the clause packaging hypothesis would predict the same pattern of agreement after both preambles because in both cases the intermediate and local nouns would constitute part of the same clause as the head noun.

Interestingly, the results of both language groups in each of their own languages showed that attraction errors were produced only when the intermediate noun differed in number with the head noun (PSP and SPS conditions) but not when it matched (PPS and SSP conditions), thus refuting both accounts. In addition, no or few errors were produced when the head noun was followed by two singular nouns (PSS), and somewhat more errors were produced when a singular head noun was followed by two plural nouns (SPP) than when it was followed by only one plural noun (SPS). The authors argued in favour of a *syntactic distance* account and postulated that what makes a clause less vulnerable than a phrase to a local mismatching number feature is the fact that the syntactic distance between a local noun and a head noun is much longer in clauses than in phrases. Thus, when syntactic constituents are

organised hierarchically in a tree structure before they are linearised for articulation (e.g., De Smedt, 1994), the subject NP is higher in the tree structure than the local NP and this prevents the latter from interfering in S-V agreement process. In the same line, the intermediate noun is higher in the tree structure than the local noun and has more chances of its number influencing verb-agreement than the local noun does. Franck et al. (2002) concluded that the processing complexity of plural number when combined with the structural factor of syntactic distance is very likely to lead to attraction errors.

In addition, and more importantly for our research, we saw that *attraction* is more common when the head noun is singular and the local noun plural than vice versa (e.g., Bock & Miller, 1991; Vigliocco et al., 1995; Hartsuiker et al., 1999). The phenomenon of so-called attraction is strongly considered to be linked with the contrasting properties of *markedness* (or lack of it) between singular and plural number. That is, the asymmetry "singular subject noun - plural local noun" has been argued to be more likely to create S-V agreement errors because the activated plural feature of the local noun overrides the default assignment by being mistakenly detected by the verb-agreement mechanism (Bock & Eberhard, 1993). Eberhard (1997) also attributes the plural attraction effect to the unmarked nature of singular number which makes it more vulnerable to the influence of plural number as opposed to plural marked elements which are considered more restricted than the unmarked ones (see Gair, 1988, for a review on Markedness). In her study, the author examined the effects of additional features to the subject noun phrase on verb-agreement. The findings showed that when the marking of singular number was enhanced (e.g., *One key to the cabinets* vs. *The key to the cabinets*) fewer agreement errors were elicited. Interestingly, when the singularity of the local noun was enhanced, the opposite effect was found. That is, more errors occurred in phrases such as *The keys to one cabinet* than *The keys to the cabinet*. In addition, enhancement of plural double-marking for local nouns did not increase the number of plural attraction errors (e.g., *The key to a few cabinets* vs. *The key to the cabinets*). Thus, the author concluded that an element that is already marked cannot be further marked. In contrast, an unmarked element can admit markedness because in this way it acquires a feature that was lacking before.

In the same line, Konieczny, Schimke and Hemforth (2004) argue that if singular is considered the default number for nouns, and if a subject noun does not carry any plural marking, then it is expected that it will pass its number to the verb. Moreover, plural lexical items are more informative and less

ambiguous, therefore, not as prone to agreement errors as singular lexical items (e.g., Bock & Cutting, 1992). Evidence of the role of markedness also comes from studies with children who have been found to display a preference for using singular verbal forms as default even when they have acquired knowledge of the plural form (e.g., Franck et al., 2004). Memory tasks also provide support of how demanding it is to process plural number in comparison to singular number, a fact that may lead speakers to preferential use of singular instead of plural. These studies show that singular nouns are more easily recalled or that plural forms are usually recalled as singular more often than vice versa (e.g., Van der Molen & Morton, 1979).

Along these lines, Hartsuiker, Kolk, and Huinck (1999) investigated the attraction effect, contrasting the performance of healthy adults with that of Broca's aphasics on S-V agreement in Dutch. In a sentence-completion task (Expts. 1 & 2) and in a sentence/picture matching task (Expt. 3), the authors manipulated the number of complex NPs, thus creating conceptually plural or conceptually singular readings (e.g., *The back of the chairs* vs. *The owner of the suitcases*), and sentence fragments in which the head noun and the local noun matched or not (e.g., *The back of the chair* vs. *The back of the chairs* and *The owner of the suitcase* vs. *The owner of the suitcases*). They sought to test the prediction that Broca's aphasics, unlike healthy adults, should rely more on grammatical number to construct S-V agreement because they lack sufficient resources to process simultaneously semantic and syntactic information (e.g., Kolk & Weijts, 1996).

In Experiments 1 and 2, the experimenter read aloud an adjective and then the sentence fragment, and participants were asked to repeat the sentence fragment and complete it with the adjective using a form of *to be*. Experiment 3 was based on the same number manipulations as the previous two experiments except that it additionally tested participants' comprehension of conceptually plural vs. singular readings. The experimenter read aloud each sentence fragment and participants were required to point to the corresponding picture out of four alternatives: (1) *The label on the bottles*; (2) *The labels on the bottles*; (3) *The labels on the bottle*; (4) *The label on the bottle*. Summarising the results of all three experiments, Broca's aphasics showed the same pattern of comprehension of complex NPs as normal controls. Also, both groups yielded the same plural attraction effect in singular head noun – plural local noun sentences. However, the fact that only normal controls yielded semantic agreement errors in conceptually plural but

grammatically singular conditions (distributivity effect) was taken as evidence that Broca's aphasics did not consider semantic information when constructing S-V agreement. This latter finding was interpreted as the consequence of a resource allocation.

In a more recent study, Hartsuiker and Barkhuysen (2006) examined Dutch speakers' performance on S-V agreement under the presence or absence of memory load. The authors tested whether the processes of working memory during sentence formulation, that is, maintaining subject noun information while computing verb-agreement, would be affected by the concurrent performance of another task. Half of the participants were asked to repeat NPs that were acoustically presented, and make full sentences by using an adjective, while at the same time remembering a set of three words. The other half were only asked to perform the primary task. The authors manipulated the number of the local noun thus creating multiple token and single token experimental conditions (e.g., *The coupon in the flyers* vs. *The cup for the winners*), as well as multiple token and single token control conditions (e.g., *The coupon in the flyer* vs. *The cup for the winner*). The whole experiment was conducted in Dutch. (We report the results that are relevant to this section of the thesis). Agreement errors replicated the attraction effect (e.g., Bock & Miller, 1991) whereby more agreement errors occurred after singular head nouns and plural local nouns than when both nouns were singular. Importantly, more errors were yielded in the memory load condition than in the no-load condition and for multiple token items (distributivity effect) than for single token items. The authors concluded that working memory limitations appear to affect correct agreement assignment because the process of verifying whether the appropriate number feature is chosen against another competing feature is cognitively costly enough by itself, let alone when it has to allocate some of its resources to another task (see also Fayol et al., 1994).

In another study in Slovak, Badecker and Kuminiak (2007) provided evidence that attraction can also result from interference from the gender of local nouns. In Slovak there are three grammatical genders (masculine, feminine and neuter), and there is evidence to suggest the existence of a hierarchy of markedness whereby feminine gender is the most marked gender followed by masculine, and last by neuter, which is considered to be the default gender of the three (Battistella, 1990). The authors sought to examine what kind of attraction would be yielded in the case of an agreement system that differentiated more than two values (a three-way gender system in Badecker and Kuminiak's study vs. a two-way

number system in other previous agreement studies). Following the grammatical markedness asymmetry between the three genders in Slovak, they predicted that Neuter-Masculine NPs should yield more errors than Masculine-Neuter NPs, Masculine-Feminine NPs should yield more errors than Feminine-Masculine NPs, and that Masculine and Feminine local nouns might behave in different ways in NPs with Neuter head nouns. The authors tested these predictions in S-V agreement using a sentence-completion task in which gender and case-ambiguity (nominative vs. accusative) of the head noun and local noun were manipulated, thus creating matched (control) and mismatched conditions (masculine vs. feminine vs. neuter in Expts.1 & 3, and masculine vs. feminine in Expt. 2). In each trial, participants heard first a "fake acronym" and then a noun phrase, while a card indicating some period of time was presented to them simultaneously. Participants were asked to make a full sentence which should refer to the time period indicated on the card. After doing so, they also had to repeat loud the acronym they had heard at the beginning of the trial.

The results (relevant to the current section of the thesis) showed that gender agreement errors occurred in a similar way to number attraction errors. That is, when the gender of the head noun mismatched with the gender of the local noun, the verb agreed with the gender of the local noun that was the most marked (Neuter-Masculine and Masculine-Feminine NPs). However, Neuter-Masculine and Neuter-Feminine preambles compared with each other did not yield a different number of agreement errors as would be expected according to a markedness account. This latter finding was interpreted in terms of an account according to which the degree of gender markedness of a local noun is defined by specific gender contrasts and not by any hierarchical order. The manipulation of case ambiguity showed that gender agreement errors were yielded only when both the head and local noun were case-ambiguous in gender mismatched conditions. The authors argued that this was evidence in support of the involvement of a working memory system in which retrieval of a lexical subject of a sentence and syntactic operation processing is based upon cues such as nominative case, occurring pre-verbally, occupying a specifier position in the VP, etc. When the local noun resonates to the retrieval of such cues as well as the head noun does, it is likely that agreement errors will occur.

2.5.1.3 Gender Agreement

Studies on gender agreement have also showed that conceptual factors play an important role in phrasal integration and that accuracy in agreement is more likely when conceptual information is congruent with syntactic information than when incongruent. (Because our immediate interest centres on number agreement, we shall not expand on this topic. But see preceding (Badecker & Kuminiak, 2007) and following (Vigliocco et al., 1995; Meyer & Bock, 1999; Hartsuiker, Schriefers, Bock, & Kikstra, 2003) reviewed studies within which gender manipulation is also mentioned).

In two studies with experiments conducted in Italian and French, Vigliocco and Franck (1999, 2001) used a sentence-elicitation task between a subject and a predicate adjective. The authors manipulated the gender (conceptual vs. grammatical) of the head noun, while local nouns always mismatched the head noun gender. Thus, nouns with conceptual number would be nouns whose gender was determined by the sex of the referent (e.g., *ragazzo* and *ragazza*; 'boy' and 'girl' in Italian, respectively). Nouns with grammatical number would be nouns whose gender was determined by the grammar of the language and not by their semantic basis (e.g., *pietra*; 'rock' (fem.), but *sasso*; 'stone' (masc.), in Italian). The prediction was that there should be no difference in error rates between the two conditions if only syntactic features were relevant to agreement computation. On the other hand, in accordance with the maximal input approach, fewer errors should be found if conceptual features were also considered in cases where the syntactic and conceptual features matched. The results supported the second prediction, showing that when conceptual features were available, agreement processing took into account this information as well.

2.5.1.4 Morphophonological Effects on S-V Agreement

One of the first studies in which morphophonology was examined in relation to S-V agreement is that of Bock and Eberhard (1993). Through a series of experiments using a sentence-completion task, the authors explored how number agreement between subjects and verbs is implemented when various features of local nouns are manipulated. Such features were semantics, whereby the local noun referred to more than one entity but was otherwise grammatically singular (e.g., *The job for the choir* vs. *The job*

for the singer), morphophonology, whereby singular words with plural-like endings (pseudoplurals) (e.g., /*-s*/, /*-z*/, /*-ez*/) were used, and grammar (e.g., regular vs. irregular plural nouns). The authors advanced three hypotheses based on each one of the above manipulations. With respect to the first one, they argued that if the verb acquires its number from the same source as the subject, then agreement responses should reflect notional number. Second, they suggested that if the verb is influenced by the overt morphophonological marker for plural number of the local noun, then utterances should reflect that. Third, if the verb just reflects the number properties of the lexical item that heads the subject noun phrase, that is, if it merely copies the number specification of the head noun, then it should reflect grammatical number.

The results showed no effects of phonological correlates (Expts. 1 & 2). That is, the only errors that occurred were after true plural local nouns, but none after plural-like singular nouns. Thus, pseudoplurals could not create attraction due to their pseudoplural nature (e.g., *The ship for the cruise* vs. *The ship for the crews*). The regularity of plural marking was not found to influence agreement errors either (Expt. 3). Namely, agreement errors were made as often for number mismatch conditions with regular plural nouns as with irregular plural nouns (*The trap for the rats* vs. *The trap for the mice*). The manipulation of the notional number of the local noun yielded attraction errors with morphologically plural local nouns (*armies* vs. *soldiers*), but not with notionally plural but morphologically singular local nouns (*army* vs. *soldier*). Thus, the authors assumed that this could be evidence for notional number contribution whereby the collective number interpretation was enhanced by the plural marking, but above all they underlined the dominance of grammatical number in S-V agreement implementation (see also Bock & Miller, 1991).

In *2.5.1.1 Semantic vs. Syntactic Influences on Verb-Agreement*, we presented the study of Vigliocco et al. (1995) whose results showed that Italian speakers are also sensitive to semantic effects (i.e., *distributivity*) during agreement computation, yielding incorrect plural verb completions following singular head nouns, normally taken to denote several tokens, such as *The label on the bottles*. Another factor that was investigated in that study, which is relevant to this section, was whether the morphological marking of number (marked vs. unmarked) of the subject noun had an effect on the probability of S-V agreement errors. In particular, the authors compared ambiguous with unambiguous morphophonological number on the subject noun (e.g., *La città sulle colline* (the-F, S town-ø, on, the-F,

P, hills-F, P) vs. *Il gatto sui tetti* (the-M, S cat-M, S, on, the-M, P, roofs-M, P), and *Le città sulla collina* (the-F, P town-ø, on, the-F, S, hill-F, S) vs. *I gatti sul tetto* (the-M, P cats-M, P, on, the-M, S, roof-M, S), creating preambles in which head nouns and local nouns matched or mismatched in number, to see whether there would be a difference in agreement errors between the unmarked and marked condition. Note that in both conditions the definite article was always marked and that in the unmarked condition only the head noun lacked number marking. The results showed that more agreement errors were yielded when the head and local nouns mismatched in number than when not. More importantly, the morphological number manipulation on the head noun yielded more agreement errors when the number of the head noun was ambiguous than when it was morphologically marked. Thus, the authors concluded that the morphological marking of the head noun can affect the rate of S-V agreement errors.

In another study, Haskell and MacDonald (2003) tested the claims of the *constraint satisfaction* account regarding competition between alternative verb forms and interaction between different sources of information during S-V agreement. (For current purposes we will focus on the latter issue). According to the *constraint satisfaction* account, the dynamics of the weighing of subtle factors may change when the latter are correlated with other conflicting factors. The authors addressed this question in a sentence-completion task by manipulating the morphological regularity of local nouns in singular head noun phrases (Expts. 2 & 3). They predicted that if morphophonological information was taken into account during agreement processing, plural local nouns bearing an overt plural marking (regular nouns) should lead to significantly more plural agreement responses than irregular plural nouns (e.g., *The cage for the spotted rats* vs. *The cage for the spotted mice*). Although Experiment 2 yielded null results replicating Bock and Eberhard's (1993) Experiment 3 of absence of influence of morphological regularity on verb-agreement, when more balanced conditions were created in Experiment 3 of this study through the addition of collective head nouns to increase the competition between the factors of notional plurality and morphophonology (e.g., *The family of rats* vs. *The family of mice*), the predicted results were yielded. Namely, there were significantly higher scores of plural agreement following morphologically regular plural nouns than irregular plural nouns. The authors argued that this was evidence in support of the constraint satisfaction approach reflecting interaction between conceptual and grammatical processes.

Morphophonological effects on S-V agreement have also been reported by Hartsuiker et al. (2003). In the first two experiments of their study, the authors examined whether case ambiguity in German between feminine and neuter gender (whereby accusative and nominative inflection on definite articles and nouns is indistinguishable for singular and for plural number respectively) might have an effect on verb-agreement. More particularly, the authors constructed prepositional NPs using local nouns that were ambiguous in form with the nominative (accusative local nouns) vs. unambiguous (dative local nouns). They hypothesized that if S-V agreement processing does not take into account morphophonology, verb-implementation should not differ between the two conditions. Alternatively, if morphophonology was considered, more attraction errors were expected in the case of accusatives than datives because the latter would be clearly marked as "non-subject like" (the appropriate marking being present both on the local noun and its article), and thus be disqualified as candidates for such a role. Similar expectations were yielded for the head noun, as singular masculine subject nouns are clearly nominative but singular feminine and neuter subject nouns are not (the marking of the latter being identical to accusatives). Following the same reasoning, the authors manipulated determiner number ambiguity of common gender nouns vs. neuter gender nouns in Dutch in the third experiment. Because the definite determiner *de* can be either singular (for common gender singular nouns) or plural (for plural nouns of either gender), whereas the definite determiner *het* is unambiguously singular for neuter gender nouns, Hartsuiker et al. (2003) investigated whether the ambiguity of the head noun's influences agreement.

The results of the experiments with German showed that plural local nouns elicited more agreement errors (*attraction* effect) than did items with a singular local noun. In addition, local noun case ambiguity combined with number ambiguity in the subject noun phrase yielded more agreement errors. That is, the verb tended to agree with the local noun phrase only when the morphological form of the latter was the same as that of the subject noun phrase. The results of the Dutch experiment replicated the attraction effect, while the manipulation of number ambiguity of the definite determiner in the head noun phrase showed an effect on S-V agreement computation by inducing more errors when the determiner of the head noun was morphophonologically ambiguous for number than when not. Thus, Hartsuiker et al. (2003) concluded that morphophonology is a factor that plays a role in the computation of S-V agreement.

2.5.1.4 Summary

To summarize, the manipulation of morphophonology has been showed to have an effect on verb-agreement, while support for lexical dominance (i.e., grammatical agreement) has been provided in the majority of these studies. We saw once more that notionally plural collective nouns can affect agreement only from a local noun position in singular head noun phrases. Plural local noun regularity was also found to affect verb-implementation, yet more clearly in conditions within which the interactivity of conceptual and grammatical sources of information was enhanced. Finally, number ambiguity of the local noun had an impact on verb-agreement only when it was combined with head noun number ambiguity, that is, when both had the same number. These results put together provide mixed evidence as to whether it is only syntactic number specification that affects agreement (minimalist view) or whether agreement processing makes use of all information available (maximalist view) (see Vigliocco & Hartsuiker, 2002, for a review).

2.5.1.5 Overall Summary of Number Agreement in Monolinguals

The section on number agreement in monolinguals showed that there is strong evidence to separate two influences on agreement. The first influence relates to the characteristics of the subject. Whereas it might initially appear that agreement is governed by the morphosyntactic form of the head noun (singular vs. plural), it is in fact also affected by the numerosity of the subject (whether it refers to one vs. many entities). The evidence for this comes from the tendency of speakers to use plurals to refer to morphosyntactically singular but semantically plural head nouns such as *team* (e.g., Bock et al., 1999, 2004), and from the tendency for morphosyntactically singular complex noun phrases with distributional construals (e.g., *The label on the bottles*) to take plurals more often than ones without such construals (e.g., *The bridge to the islands*) (e.g., Vigliocco et al., 1995). The second influence comes from the embedded noun in complex NPs which "attracts" the number of the verb into its number, even though the verb normally agrees with the head noun. Most evidence suggests that this influence is morphosyntactic (e.g., Bock & Eberhard, 1993) and is strongly asymmetric, with a plural local noun overriding a singular head noun much more often than the reverse (e.g., Bock & Miller, 1991).

Theoretically, these results suggest that speakers first construct a conceptual representation of the whole subject. Semantic agreement occurs when speakers use this representation to construct agreement. Speakers then construct syntactic representations for the lemmas that make up the subject. Normally, syntactic agreement involves the use of the lemma for the head noun, but occasionally the lemma for a different noun governs agreement instead (in which case, it "attracts" the verb into agreeing with it). This account fits most naturally with a feed-forward model in which conceptual formation precedes lemma access (e.g., Levelt et al., 1999), and therefore where semantic agreement occurs earlier than syntactic agreement (Bock et al., 2001, 2006). However, it is also compatible with interactive accounts in which concept and lemma are clearly distinguished and where agreement follows from one or other representation (Vigliocco et al., 1996b).

2.5.2 The Bilingual Case

How can we use the evidence from monolingual agreement to develop an account of bilingual agreement? We mentioned earlier that most accounts assume that bilinguals have a single conceptual representation of words and their translation equivalents because their meaning is the same (e.g., Kroll & Tokowicz, 2001). But clearly they must have different lemmas, at least when they have different grammatical properties. For example, *hair* and *μαλλιά* ('hair' in Greek) refer to the same entity, but *hair* is grammatically singular whereas *μαλλιά* is grammatically plural. What might number divergence entail about the interaction between the syntactic properties of bilinguals' languages during sentence construction? If we assume that the common conceptual representation activates both grammatical systems, which language properties should prevail during sentence processing and why? Could there be any instances where the non-response language might interfere in the process of sentence construction? Could it be possible that the different way of grammatically expressing number across languages reflects a difference in its conceptualization?

2.5.2.1 Interference vs. Non-Interference in the Monolingual Mode

So how do bilinguals construct agreement? We have assumed that translation-equivalent words have different lemmas but share a concept (e.g., Kroll & Stewart, 1994; Kroll & de Groot, 1997). The most obvious account of agreement therefore has them use the concept node to construct semantic agreement, and use one or other lemma node to construct syntactic agreement. For this model to be correct, similar mechanisms must govern L2 agreement as govern L1 agreement. Support for this assumption comes from Nicol and Greth (2003), who had English native speakers of Spanish L2 perform a sentence-completion task in both languages (with at least two days between each language session), using grammatically singular complex noun phrases with distributive versus non-distributive construals and singular versus plural local nouns (cf. Vigliocco et al., 1995). Participants produced nearly identical patterns of completions in the two languages (with plural verbs occurring after plural but not singular local nouns, and more plurals occurring for distributive than non-distributive subjects). We therefore tentatively assume that L1 and L2 agreement are computed similarly, but clearly further evidence for this claim would be valuable.

If this model is correct, then the main empirical question is to determine which node governs agreement for any given utterance. The most straightforward *non-interference* account would simply have bilinguals choose the appropriate language and then produce either syntactic or semantic agreement. Consequently, in cases where a bilingual has set *a priori* a specific "goal", for instance, speak in only one of her languages (monolingual mode), the non-response language might not be activated enough to become available (de Groot, 1998; Roelofs, 2002; but see Thomas & Allport, 2000). However, lexical research (e.g., Costa et al., 1999) suggests that both languages can become activated during production, even in cases where only one of the languages is intended for articulation (De Bot, 1992; Green, 1986; Poulisse & Bongaerts, 1997). So it is possible that grammatical information associated with the non-response language will affect the computation of grammatical agreement. We call this the *interference* account. For example, if a Greek-English bilingual tries to utter *The hair is*, she may activate the Greek lemma *μαλλιά* ('hair'). Because that lemma is plural, its activation may lead to activation of *are*, so that the speaker may perhaps produce **The hair are*. Evidence for shared syntactic representations comes from cross-linguistic syntactic priming (Loebell & Bock, 2003; Hartsuiker et al., 2004; Salamoura &

Williams, 2006, see also Hartsuiker & Pickering, submitted, for a recent review), but there is currently no evidence either for interference between languages in cases of grammatical mismatch, or for effects of the non-response language in the computation of agreement.

Interference may of course occur under some conditions but not others. One possibility is that L1 lemmas become activated (or sufficiently activated) during L2 production, but not vice versa (see also Kroll, Bobb & Wodniecka, 2006). For example, a person with L1 Greek and L2 English might sometimes say **The hair are*, but a person with L1 English and L2 Greek might never do so (see MacSwan, 2005, for a similar proposal of asymmetry reported in Spanish-English CS, and Bernardini & Schlyter, 2005, for differential production of CS in bilingual children). Additionally, the factor of the mode of speech might correlate with the occurrence or degree of influence of the non-target language during agreement construction. That is, we might expect more influence of the non-target language when the speaker uses both languages, or perhaps hears the non-target language in the same session (bilingual mode) than when the speaker is engaged in a session of single-language use (monolingual mode). Finally, it is possible that influence of the non-target language becomes more pronounced when speakers are placed under stress (e.g., they need to construct utterances quickly) or when the utterances are complex (de Groot & Christoffels, 2006).

2.5.2.2 Interference vs. Non-interference in the Bilingual Mode

So far we have considered cases in which a bilingual produces an utterance in one language (monolingual mode), and have asked whether their knowledge of the non-target language affects the construction of verb-agreement especially when there is number divergence between the two activated noun lemmas. We have also mentioned that although agreement constitutes a relation (or dependency) between two elements, in this case subject and verb, evidence from naturalistic data on code-switching suggests that speakers often produce the subject in one language and then produce the verb in the other language (MacSwan, 2000; Callahan, 2002) (e.g., Les canadiens *scrivono*; 'The Canadians are writing', French/Italian: quoted in Muysken, 1995). Intra-sentential code-switching at this switch site is our focus in the present study and raises a number of interesting questions with respect to agreement implementation.

One linguistically prominent issue is what happens when there is a discrepancy between two languages. For example, linguists have asked how people deal with discrepancies between the two languages' word orders. In adjective-noun switches, for instance, the question is what kind of word order is applied to CS when in one language an adjective precedes a noun (e.g., *green apple*), whereas in another language it is the other way round (e.g., *pomme verte*; in French). An account that has been proposed states that adjective-noun switch follows the rule of the language of the adjective (McClure, 1977). Therefore, a code-switched utterance such as I bought a *verte pomme* would be considered ill-formed because it violates the rule of adjective-noun word order in French (but see Muysken, 2000, for contradictory data from Dutch/English CS).

In view of the issue of language-discrepancy in CS, which is closely related to the focus of our study, we mentioned in section *2.2 Bilingual Speech Production: Variables and Definitions* that many linguists recognize that language interaction may lead to structures that display evidence of "interference" (e.g., Myers-Scotton & Jake, 2001). Moreover, lack of sufficient congruence between the two language systems at any level of representation may lead to compromise structures in code-switched speech (Myers-Scotton, 2002). From the perspective of language production, when there is no discrepancy between two languages, intra-sentential CS should be straightforward. Let us consider an example of subject-verb agreement to illustrate this. For instance, in a sentence such as Todos los estudiantes *are freaking out* ('All the students are freaking out', Spanish/English: quoted in Montes-Alcalá, 2001), the speaker continues to obey the syntactic restrictions imposed by the initial fragment of the sentence in producing the completion, but deactivates the source language and activates the target language instead. In this way, the verb in language B could acquire the number specification of the subject noun of language A, and S-V agreement would follow the same rules of monolingual agreement construction even if it were realized into two different languages. Obviously, this is most straightforward in which syntactic information is shared between languages (e.g., Hartsuiker et al., 2004; Desmet & Declercq, 2006).

What happens though when there is a mismatch between the features of the two language systems? Would bilingual speakers stick to the grammatical properties of the source-language and make the verb in the target-language agree accordingly, or would the activation of the subject noun counterpart be

strong enough to pass its number specification to the produced verb? For example, in the case of a subject noun whose number diverges between the two languages (e.g., *hair*; singular in English but plural in Greek), speakers are faced with a problem: should they continue to activate the divergent property (e.g., singular number) of the source language, or should they activate the corresponding property of the translation equivalent noun in the target language (e.g., plural number)? If they continue to activate the divergent property of the source language, they should produce utterances such as The hair *είναι-sg* ('The hair is') or Τα μαλλιά *are* ('The hair are'), in which the verb agrees in number with the subject. But if they activate the corresponding property of the target language, they should produce The hair *είναι-pl* or Τα μαλλιά *is* instead, and therefore make the verb agree in number with the translation of the subject. Thus, the questions that rise are whether we could witness patterns of influence on verb output due to the native language (L1) or source-language (e.g., Myers-Scotton et al., 2001), and whether subject noun feature conflict across the two languages might yield "compromise structures", that is, structures that do not accord with any of the two languages' grammar if considered in isolation. Findings of this kind would add to the existing compromise strategies that have been attested in other studies of code-switched speech (Myers-Scotton, 2002).

Whereas speakers may obey a (fairly) strong constraint over whether to agree with the subject or its translation, it is also possible that their behaviour depends on the conditions under which such code-switching occurs. So far, we have suggested that the extent to which bilingual speakers are affected by the non-target language when producing single-language utterances (monolingual mode) may depend on factors such as which language is their preferred or native language, and whether they are producing both languages during the same session or not (monolingual vs. bilingual mode). We shall see that further variables that were raised in monolingual agreement literature which have showed to affect agreement, such as the semantics as well as language-specific morphology and markedness (e.g., plural number), should also be considered as possible influence on the choice of form in code-switching.

And what about pronoun-agreement (i.e., tags, in this thesis)? In Chapter 5, we will review studies from monolingual research on number agreement with pronouns that show that pronoun-implementation (as opposed to verb-implementation) is influenced by the notional, rather than the morphological number of the controller (e.g., Bock, Eberhard, & Cutting, 2004; Eberhard, Cutting, & Bock, 2005). The impact

of the non-target language on pronoun-implementation in the target language has received no attention in bilingual or code-switching literature despite frequent use of tag pronouns in everyday speech. For instance, there are reported data on the occurrence of *tag-switching* in natural speech, that is, a switch between an utterance and the tag (Milroy & Muysken, 1995), but Myers-Scotton has confirmed that there are no CS studies that have examined this issue (personal communication, November 28, 2006). Thus, we were interested to see whether we could find similar mechanisms governing L2 pronoun-agreement as L1 pronoun-agreement, or whether it is a syntactic phenomenon that is differently instantiated across languages. All these questions were addressed in our research.

2.6 Present Study Reminder

We feel at this point that it is worth returning to the specifics of the present study before we pass to the experimental chapters. In what follows, we present an investigation of the construction of verb- and pronoun-agreement in bilinguals. We look at the effects of subject nouns whose grammatical number differs between Greek and English (*divergent nouns*); for example, *hair* is grammatically singular but its translation *μαλλιά* is plural. In contrast, *παντελόνι* ('trousers' in Greek), when referring to one pair of trousers, is singular but its translation *trousers* is grammatically plural. We also consider the construction of agreement when the subject is a *convergent noun* whose grammatical number does not differ between Greek and English (e.g., *tree* and its translation *δέντρο* are both grammatically singular and *books* and its translation *βιβλία* are both grammatically plural). In addition, we manipulate the mode of speech within which verb- and pronoun-agreement take place (monolingual vs. bilingual). In all cases, the question is whether speakers produce singular or plural agreement. This would allow us to test various different interference accounts such as whether it is the syntax of the non-target language rather than semantics that may affect agreement computation.

Moreover, apart from providing evidence about degree of language integration, the specific pattern of results should be informative about the process of bilingual agreement. For example, much of the monolingual literature has used complex subjects with agreement mismatches between the head noun and the local noun (e.g., *The label on the bottles*). It has shown striking effects of markedness (e.g., Vigliocco et al., 1995; Humphreys & Bock, 2005), whereby participants are much more likely to produce a plural

following a singular head but plural local noun (e.g., *The label on the bottles are*) than a singular following a plural head but singular local noun (e.g., *The labels on the bottle is*). Does the non-target language behave in a similar way to the local noun? If so, bilinguals should be more likely to produce **The hair are* when the translation equivalent of the non-target language is plural (i.e., *μαλλιά*) than *Τα μαλλιά είναι*-SG ('The hair is') when the translation equivalent of the non-response language is singular (i.e., *hair*). Finally, looking at pronoun-agreement in a pair of languages that has not been studied before would allow us to test two hypotheses: (i) whether the implementation of pronoun-agreement is subject to the same effects as verb-agreement, and (ii) whether pronouns are processed in the same way or not by speakers of a different native language (e.g., English vs. Greek).

CHAPTER 3

Sentence Production in the Monolingual Mode: Verb-Agreement

3.0 Chapter Overview

In this chapter we report two experiments in which we look at whether the underlying number of the non-target language influences production in the target language. In Experiment 1, Greek-English bilinguals perform a sentence-completion task where they produce utterances in the monolingual mode (single-language completion in the L2). In Experiment 2, we replicate Experiment 1 with English-Greek bilinguals to study whether bilinguals of a different native language display similar agreement computation mechanisms and possibly interference from their L1 when producing utterances in the L2 in a monolingual-mode setting.

3.1 Grammatical and Syntactic Properties of Greek and English Relevant to Our Study

Greek is a language with rich inflectional system and flexible word order. S-V agreement is encoded in the inflectional ending of the verb or predicate adjective which is marked for person and number (Joseph & Philippaki-Warburton, 1987). The determiner system in Greek distinguishes between definite and indefinite articles which are inflected for case, number and gender. With regard to definite articles (which are the ones we used to make our materials), "ο" is used for masculine, "η" is used for feminine, and "το" is used for neuter for nominatives in singular number; "οι" is used for masculine and feminine, and "τα" is used for neuter for nominatives in plural number. In a noun phrase (NP), definite articles in Greek also agree in number and gender with the nouns they modify (Tsimpli, 2003), as shown in the following examples:

(1) a. Ο σκύλος είναι άγριος
the-NOM-MASC-SING dog-NOM-MASC-SING is-3SG wild-NOM-MASC-SING
"The dog is wild"

b. Οι σκύλοι είναι άγριοι
the-NOM-MASC-PL dogs-NOM-MASC-PL are-3PL wild-NOM-MASC-PL
"The dogs are wild"

(2) c. Η πόλη είναι μεγάλη

the-NOM-FEM-SING town-NOM-FEM-SING is-3SG big-NOM-FEM-SING

"The town is big"

d. Οι πόλεις είναι μεγάλες

the-NOM-FEM-PL towns-NOM-FEM-PL are-3PL big-NOM-FEM-PL

"The towns are big"

(3) e. Το βιβλίο είναι παλιό

the-NOM-NEUT-SING book-NOM-NEUT-SING is-3SG old-NOM-NEUT-SING

"The book is old"

f. Τα βιβλία είναι παλιά

the-NOM-NEUT-PL books-NOM-NEUT-PL are-3PL old-NOM-NEUT-PL

"The books are old"

In English, the verb agrees with the subject noun in person and number, yet agreement can be attested only in present tense 3rd person singular, since in all other instances of person and number the verb lacks any distinctive marking. Moreover, the definite article is not inflected for number nor has distinct singular and plural form (Curme & Kurath, 1931).

EXPERIMENT 1: Sentence-Completion in L2 (English) by Greek-English Bilinguals

3.2 Rationale and Predictions

Experiment 1 investigates the production of number agreement in the L2 in the monolingual mode (i.e., when participants never produce L1). It contrasts convergent subject nouns (where the noun has the same grammatical number in both languages) and divergent subject nouns (where the noun is grammatically singular in one language but plural in the other). We also report two post-tests (i.e., a translation test and a grammaticality forced-choice test). With regard to divergent nouns we note that those which are singular in English but plural in Greek belong to the category of *mass nouns* (e.g.,

baggage) as they cannot take a plural form nor an indefinite article or a quantifier, and are assumed to differ semantically from count nouns as they denote "stuff", properties, abstractions or collections (Taler, Jarema, Saumier, 2005). Those which are plural in English but singular in Greek belong in their majority to *binary nouns* (or else, *bipartites*) (e.g., *scissors*) which although are plural in form and take a plural verb, are considered a single entity (see *Materials* section for more information).

So far, only one monolingual study has examined agreement using similar nouns (i.e., Bock et al., 2001) in which they were manipulated in local noun position (e.g., *The advertisement for the scissors* vs. *The advertisement for the razors*). The authors sought to investigate the effects of grammatical and conceptual number in attraction, that is, when the local noun differed in grammatical and/or conceptual number from the head noun. In Experiment 1, English and Dutch monolinguals were asked to provide sentence-completions (each bilingual group in their language) for local-noun phrases with bipartites such as the example cited above. The results for English speakers showed that bipartites created significantly more attraction than singular controls (e.g., *razor*), but significantly less attraction than plural controls (e.g., *razors*). For Dutch speakers, bipartites created no attraction effect as these nouns are singular both morphologically and notionally in Dutch. Nonetheless there was the usual plural attraction effect of plural verbs following plural control local nouns. In Experiment 2, English speakers performed the same task with local nouns that were morphologically and notionally plural (*pluralia tantum*) (e.g., *The color of the soap suds* vs. *The color of the soap bubbles*), and in Experiments 3 and 4, English and Dutch speakers completed local-noun phrases with collectives (e.g., *The record of the team* vs. *The record of the teams* vs. *The record of the players*) that could be morphologically singular or plural but notionally plural, and mass nouns (e.g., *The photo of the class* vs. *The photo of the pupils*) that were morphologically singular but considered notionally plural. The results showed that plural notional number was not sufficient to create attraction since singular collectives and mass nouns behaved like singular controls. All in all, the findings from this study led Bock and colleagues to argue that what matters in attraction is the morphological rather than the notional properties of the local noun.

In the present bilingual study, we manipulate the conceptual and morphological properties of nouns whose number diverges across languages by placing them in subject position. We assume that since a subject is central to the structure and meaning of sentences and plays a pivotal role in the hierarchy of

grammatical relations, the effects a noun has in this position may be different from the effects of a local noun. Evidence in support of this claim comes from studies on S-V agreement with collective nouns whose notional number has been found to affect V-agreement only when these nouns have been in subject position (e.g., Bock et al., 1999; Humphreys & Bock, 2005). In addition, we are interested to see whether the plural translation equivalent of a singular subject noun in the non-target language (if activated) might behave as a "local noun" thus creating plural verb-agreement (e.g., **The hair are short*). For convergent nouns, we predict that verb-agreement will be straightforward as there will be no mismatch in number across languages to create any kind of feature competition.

Regarding language activation, in the chapter of literature review we presented enough evidence to suggest that bilinguals consider the non-target language with respect to lexical processing even if only one language is intended for articulation (e.g., Costa et al., 1999; Hermans, 2000). The question of interest in this study is whether number divergence is a strong enough factor to trigger activation of both languages in bilingual speakers, and whether the non-target language (L1) can be activated to such an extent to interfere in the computation of S-V agreement in the target language (L2).

3.3 Method

3.3.1 Participants

Twenty-two fluent bilinguals who were native speakers of Greek and spoke English as a second language (L2) were paid to participate. They were all post-graduate students at the University of Edinburgh. They had received formal instruction in English (which included systematic practice involving rules and grammar, listening and reading comprehension, as well as plenty of opportunities for conversation) through private tuition for a mean of 7 years (SD = .51) before moving to the UK, and had been using their L2 on an everyday basis. Their mean age was 25 years (SD = 1.6). Participants were recruited through advertisements which clearly stated as a prerequisite proficiency in the bilinguals' second language. In addition, two post-tests (translation and grammaticality judgement; see section *3.3.3*) were administered to ensure that all participants had achieved an advanced level in their L2 (English). As we shall see below, Greek-English bilinguals' nearly perfect performance on both tests (particularly in the grammaticality judgement task, M = 96-98% of correct responses for divergent nouns and M = 100%

of correct responses for convergent nouns) demonstrated that they possessed the relevant grammatical knowledge of agreement (i.e., which form – singular or plural – was correct).

3.3.2 Materials

The items were 144 English noun phrases, consisting of *The* plus a noun. There were 96 convergent nouns: 48 were singular in English and had a singular translation in Greek; 48 were plural in English and had a plural translation in Greek. In addition, there were 48 divergent nouns: 24 were singular in English and had a plural translation in Greek (*Collins Cobuild English Grammar*, 1994); 24 were plural in English and had a singular translation in Greek (Greenbaum & Randolph, 1990). (The complete list of the materials is reported in Appendix A). Thus, the following four conditions were formed: English singular convergent subject-noun, English plural convergent subject-noun, English singular divergent subject-noun, and English plural divergent subject-noun. The materials were collected from the *Collins Compact English Dictionary* (1993), the *Collins Cobuild English Grammar* (1994), and Johansson's (1980) *Plural Attributive Nouns in Present Day English*. The 144 item-list contained one version of each of the divergent nouns and one version of the convergent nouns which occurred only once in the list. The order of presentation was individually randomized and there were at least two convergent nouns that preceded or followed any divergent noun.

3.3.3 Post-Tests

3.3.3.1 Oral Translation

An oral translation test was conducted after the end of the experiment to test participants' vocabulary and morphological number knowledge of the experimental items in the L2. Four randomized lists were constructed of 96 noun phrases each: 48 divergent nouns (half in singular number and half in plural number) and 48 randomly selected convergent nouns (half in singular number and half in plural number) that were the Greek translation equivalents of the corresponding subject nouns used in the experiment (see Appendix A). Greek translations were drawn from the *English-Greek Dictionary "Ta Nea", Publication Pelekanos* (1998), from the *Greek Dictionary of Modern Greek* (Mpampiniotis, 1998), and from the *Modern Greek Grammar* (1993). The experimenter read aloud each noun phrase and the

participants repeated it and translated it into English by making a full sentence (e.g., Experimenter: *Το παντελόνι* → Bilingual: *The trousers are black*). The experimenter repeated each noun phrase once, if participants needed to hear it again before responding; participants were allowed 3-4s to respond before the experimenter read the following noun phrase. All responses were recorded and transcribed for further analysis, and they were allocated to the following categories: answers in singular, plural, omissions, and miscellaneous (i.e., when the English translation was not equivalent to the Greek noun phrase). (See Table 1).

	Divergent Nouns		**Convergent Nouns**	
Translation Direction	**Greek-English (L1-L2)**		**Greek-English (L1-L2)**	
	Pl (Greek) *Τα μαλλιά* ↓ **Sg (English)** *The hair is short*	**Sg (Greek)** *Το παντελόνι* ↓ **Pl (English)** *The trousers are black*	**Sg (Greek)** *Το δέντρο* ↓ **Sg (English)** *The tree is green*	**Pl (Greek)** *Τα βιβλία* ↓ **Pl (English)** *The books are old*
Scores (%)				
Correct	95	92	100	100
Errors	3	3	0	0
Omissions	2	3	0	0
Misc.	0	2	0	0

Table 1. Example sentences from oral translation test and results (%) for divergent & convergent nouns. (Singular = Sg; Plural = Pl).

We conducted two-paired sample t-tests on correct translations comparing convergent and divergent nouns for translations whose number in the target language was singular, and convergent and divergent nouns for translations whose number in the target language was plural. (In the following analysis as well as in all the analyses throughout the thesis my chosen alpha level is set at .05). The results showed significantly more correct translations in singular number for convergent nouns than for divergent nouns; M = 100% vs. M = 95%, respectively [$t_1(21) = 10.96$; $t_2(23) = 2.88$]. That is, Greek-English bilinguals had no difficulty translating an L1 singular noun into an L2 singular noun and producing a grammatically correct sentence (e.g., *Το δέντρο* → *The tree is green*), but they sometimes produced a sentence

incorrectly (3%) when translating an L1 plural noun into an L2 singular noun (e.g., *Τα μαλλιά* → **The hair are short*). The difference between convergent and divergent nouns for correct translations in plural number was also significant, whereby no errors were made when speakers translated an L1 plural noun into an L2 plural noun (e.g., *Τα βιβλία* → *The books are old*), but 3% errors were yielded when they translated an L1 singular noun into an L2 plural noun (e.g., *Το παντελόνι* → *The trousers is black); M = 100% vs. M = 92%, respectively [$t_1(21) = 12.27$; $t_2(23) = 2.50$]. Thus, the results of the translation test confirmed Greek-English bilinguals' high fluency in the L2, but also showed that noun number divergence across the two languages posed difficulties in the correct retrieval of the number properties of the target translation in the L2.

3.3.3.2 Grammaticality Judgement

In addition, a grammaticality judgement test investigated participants' agreement knowledge in the L2. We constructed four randomized lists of 96 sentences each: 48 divergent-noun sentences (half in singular number and half in plural number), and 48 convergent-noun sentences (half in singular number and half in plural number) based on the nouns used in the experiment (see Appendix B). Each noun appeared in a subject position. Each sentence was presented in two formats, one grammatically correct (e.g., *The hair is short*) and one with erroneous subject-verb agreement (e.g., **The hair are short*). Participants were instructed to read each pair and circle which of the two sentences they considered grammatically correct. Responses were calculated for correct S-V agreement after convergent and after divergent subject nouns. (See Table 2).

	Divergent Nouns		**Convergent Nouns**	
	Singular	**Plural**	**Singular**	**Plural**
	A. *The hair is short*	A. *The trousers is black*	A. *The tree is green*	A. *The books is old*
	B. *The hair are short*	B. *The trousers are black*	B. *The tree are green*	B. *The books are old*
Scores (%)				
Correct	96	98	100	100
Errors	4	2	0	0

Table 2. Example sentences from the grammaticality judgement test and results (%) for divergent & convergent nouns.

The results of two-paired sample t-tests on correctly inflected singular and plural verbs revealed a significant difference between correctly inflected verbs after singular convergent subject nouns and after singular divergent subject nouns in the analysis by participants, whereby more correct responses were yielded in the former than in the latter; M = 100% vs. M = 96%, respectively [$t_1(21) = 7.60$; $t_2(23) = 2.04$]. That is, no errors were yielded for L2 singular nouns whose number was the same in L1 (e.g., *The tree is green*), but there were 4% errors for L2 singular nouns whose number was plural in L1 (e.g., **The hair are short*). The difference between convergent nouns and divergent nouns for correctly inflected verbs in plural number was also significant. That is, no errors were yielded for L2 plural nouns whose number was the same in L1 (e.g., *The books are old*), but there were 2% errors for L2 plural nouns whose number was singular in L1 (e.g., **The trousers is black*); M = 100% vs. M = 98%, respectively [t_1 (21) = 4.58]. (The standard error of the difference between the two conditions for the item analysis was 0). Thus, the results of the grammaticality judgement test reflected bilinguals' competence in the L2 despite the occurrence of few errors due to number divergenge across the two languages. Interestingly, considerably more correct responses were yielded in L2 plural divergent noun condition (*trousers*) in the grammaticality judgement test than in the corresponding condition in the translation test; M = 98 vs. M = 92 [$t_1(21) = 7.03$; $t_2(23) = 2.50$]. We assume that this was due to the differential degree of processing difficulty participants were faced with in each task (translation vs. comprehension) as well as the modality of each task (oral vs.written).

3.3.4 Procedure

Participants were seated at a computer in a booth and were instructed entirely in English. On each trial, a fixation point was displayed at the centre of the screen for 1500 ms, followed by the item for 2000 ms. Participants had to read the item aloud and produce a completion in the same language (here English). After 2000 ms, a fixation point followed and then the next sentence would appear. Participants were asked to perform the task as fast as possible. The session began with 8 practice trials, by using four singular and four plural convergent subject nouns none of which was included in the experiment. This allowed the experimenter to ensure that participants had understood the task. The experiment lasted about ten minutes. All answers were recorded and transcribed for further analysis.

3.3.5 Scoring

Responses in *singular* were scored when participants produced a verb in *singular*; responses in *plural* were scored when the produced verb was in plural, *omissions* when no answer or incomplete responses were given, and *miscellaneous* responses when the verb produced was unspecified for number. The initial response was scored on occasions when participants corrected themselves.

3.3.6 Design and Data Analysis

A 2 noun-type (convergent vs. divergent) x 2 noun-number (singular vs. plural) within-participants, between-items design was created. The dependent variables were answers in singular, plural, omissions, and miscellaneous. Two analyses of variance with the proportions of the dependent variables, one for participants ($F1$) and one for items ($F2$) were carried out.

3.3.7 Results

Percentages of responses in the four scoring categories are shown in Table 3.

Sentence Completion in L2 (English)

Subj.-Noun Condition		**Scores** Singular	Plural	Omissions
Conv.	Singular (*tree*)	100	0	0
	Plural (*books*)	0	99	1
Div.	Singular (*hair*)	95	4	1
	Plural (tr*ousers*)	1	96	3

Note: No miscellaneous responses were yielded

Table 3. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Divergent = Div.).

Application of the scoring criteria for singular and plural inflected verbs, omissions and miscellaneous responses are reported in Table 4.

Source of variance		**F1** (1,21)	**F2** (1,140)
		F1 value	**F2 value**
Singular	Noun-type	55.299***	14.752***
	Noun-number	94982.955***	30346.308***
	NT x NN	103.530***	30.778***
Plural	Noun-type	2.100	.326
	Noun-number	244398.0***	20888.718***
	NT x NN	136.080***	26.434***
Omissions	Noun-type	29.461***	10.859***
	Noun-number	8.768**	3.043
	NT x NN	.534	.338
Misc.	Noun-type	1.000	1.511
	Noun-number	.107	.168
	NT x NN	.107	.168

Table 4. Results of 2-way ANOVAs with the proportions of singular and plural inflected verbs, omissions and miscellaneous responses (factors: noun-type (NT) and noun-number (NN)). In accordance with standard notation, the *p* value is marked on the *F* values shown in brackets: $p > .05$ (no star); $p < .05$ (*); $p < .01$ (**); $p < .001$ (***). In addition, where *p* values were between .05 and .10 (suggesting marginal significance) we include the *p* value in brackets after the *F* value.

The main effect of noun-type was significant only for singular number (F_1 (1,21) = 55.30; F_2 (1,140) = 14.75). There was a significant main effect of noun-number for responses in singular (F_1 (1,21) = 94982.96; F_2 (1,140) = 30346.31), and for responses in plural (F_1 (1,21) = 244398.0; F_2 (1,140) = 20888.72). Importantly, there was a significant interaction between noun-type and noun-number for both singular (F_1 (1,21) = 103.53; F_2 (1,140) = 30.78) and plural responses (F_1 (1,21) = 136.08; F_2 (1,140) = 26.43), showing that more errors were yielded following singular and plural divergent nouns (*hair/trousers*) than singular and plural convergent nouns (*tree/books*). Thus, overall performance in the L2 was very good, with convergent nouns being easier to process (there was only 1% of omissions following plural nouns), and verbs being always correctly inflected to agree with them in comparison to divergent nouns. In the latter, more errors and more omissions were yielded, especially following an L2 singular divergent noun whose L1 counterpart was plural (e.g., *hair*; see Table 4). (Figure 3 shows a

comparison of proportions of correctly inflected verbs with convergent and divergent nouns, and error bars with 95% confidence intervals).

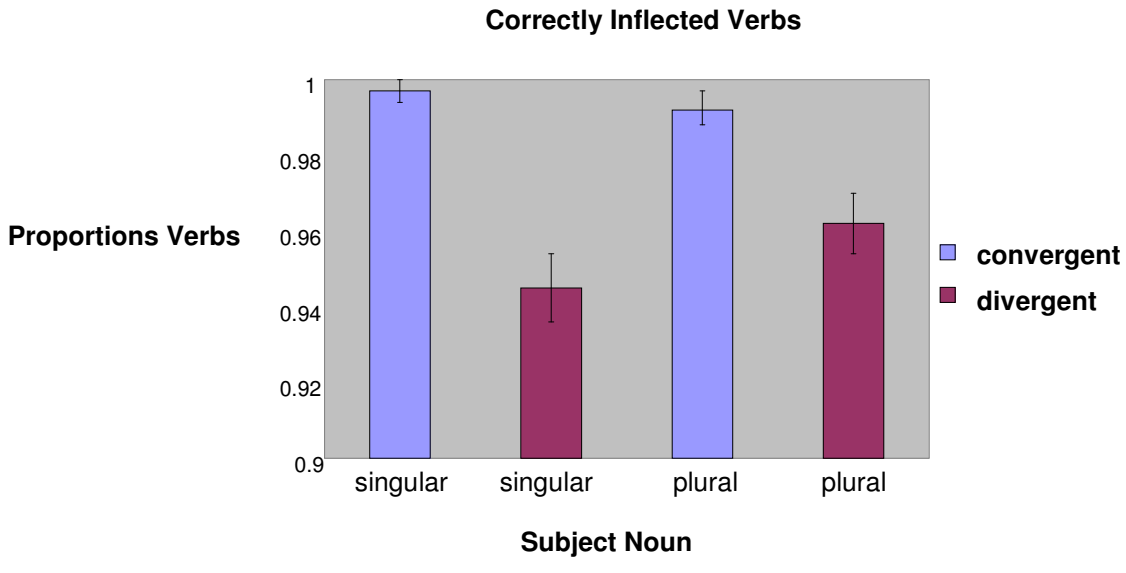

Figure 3. S-V Agreement in L2 (English) single-language production (monolingual mode) by Greek-English bilinguals for singular and plural correctly inflected verbs: Convergent vs. Divergent Nouns.

3.4 Discussion

The findings from Experiment 1 provide further support for the claim that the non-target language is accessed even when only the target language is required for a cognitive task (e.g., Spivey & Marian, 1999; Marian & Spivey, 2003, for evidence from eye-tracking studies on Russian-English bilinguals). That is, although Greek-English bilinguals' performance on verb-agreement in the L2 was satisfactory displaying their high level of L2 fluency, it also yielded a small, yet significant number of agreement errors. One possibility is that this reflects unsuccessful total deactivation of the non-target language, in other words that speakers were influenced by the number of the relevant noun in their L1.

Similar findings have also been observed in other studies where bilinguals, even if they are put in a "monolingual mode", still display signs of influence from the non-target language (e.g, Grosjean, 1995;

Colomé, 2001). For example, in their study Hermans et al. (1998) asked Dutch-English speakers to name pictures in their L2 (English). The authors manipulated the relation of word distractors (phonologically or semantically related/unrelated) to picture naming and obtained evidence showing that semantic features of the response language (English) were more strongly activated than semantic features from the non-response language (Dutch). However, there was also evidence in support of lemma activation of the non-target L1 prior to L2 lemma selection for production.

An important issue concerning the materials that needs brief discussion is the fact that the Greek singular divergent nouns (e.g., *παντελόνι*; 'trousers') mainly belonged to the same semantic class (i.e., clothing to be worn on the lower body covering the legs), whereas the Greek plural divergent nouns (e.g., *μαλλιά*; 'hair') were much more heterogeneous – the only thing they seemed to have in common was that they were mass nouns. Thus, one might argue that the Greek singular divergent nouns were more activated because the items were semantically related and primed each other. However, this idea does not fit the results that we obtained since more influence of the non-target language (Greek) was observed for Greek plural divergent nouns than for Greek singular divergent nouns, both in Experiment 1, and in all the experiments of the thesis that involved these items (Experiments 3-7).

In our study we found that speakers yielded more agreement errors following singular subject nouns whose L1 counterpart in the non-target language was plural (e.g., *hair*; 'μαλλιά'-PL in Greek) than following plural subject nouns whose L1 counterpart in the non-target language was singular (e.g., *trousers*; 'παντελόνι'-SG in Greek). This can be interpreted in terms of the pattern of agreement errors found in monolingual agreement literature whereby more errors are yielded in number mismatch conditions between the subject noun and the local noun than when both subject and local noun have the same number. As we mentioned in the chapter of literature review, agreement errors found in NPs with singular subject nouns and plural local nouns are attributed to markedness (e.g., Bock & Eberhard, 1993). That is, because singular number is unmarked, it is more vulnerable to the influence of plural number which is marked, and therefore able to attract agreement more often than the singular (see also Eberhard, 1997, for an account on the differential nature of singular and plural number and the effects of the latter on S-V agreement). Thus, we argue that the *attraction* effect may even occur cross-linguistically as long as there are two lemmas (a singular lemma in L2 vs. a plural lemma in L1) that compete for selection of a

subject NP. Since we have assumed that both lemmas are activated during agreement computation in bilinguals, a plural lemma from the L1 (which is semantically and morphologically marked, thus, most likely highly activated) might override the syntactic properties specified by a singular lemma from the L2 and erroneously percolate into a subject noun position when syntactic constituents in the L2 are hierarchically integrated into a processing structure before they are articulated (e.g., Bock & Cutting, 1992). Although the focus of the present study is to investigate the impact of the non-target language on processing in the target language rather than provide a syntactic theory of agreement, in General Discussion we propose tentatively a model of bilingual sentence production which considers language interaction effects during agreement computation.

Alternatively, incorrect S-V agreement with these nouns might reflect a semantic effect resulting from the shared concept (e.g., *hair* being semantically plural) and not due to a syntactic effect of the syntactic properties of the activated lemmas in the non-response language. We investigate these alternatives in Experiments 3, 4, and 5. In the next experiment, we replicate Experiment 1 with English-Greek bilinguals.

EXPERIMENT 2: Sentence-Completion in L2 (Greek) by English-Greek Bilinguals

3.5 Rationale and Predictions

In Experiment 2 we replicate Expt. 1 with English native speakers whose second language is Greek to examine whether bilinguals display similar language processing across languages, and whether the effects of contrasting number between two languages are comparable in bilinguals with a different L1 when producing utterances exclusively in their L2. Apart from the main experiment we also report two post-tests (i.e., a translation test and a grammaticality forced-choice test).

3.6 Method

3.6.1 Participants

Twenty-two English-Greek fluent bilinguals who were native speakers of English and spoke Greek as a second language were paid to participate. Their average age was 50 years (SD = 2.45), and had received formal instruction in Greek (which included grammar rules, and plenty of opportunities for conversation as well as directed self-study) through private tuition for a mean of 4 years (SD = .78) before moving to Greece. At the time of the testing, they had been living in Greece for 8 years (SD = 1.81), and had been using their L2 on an everyday basis. As in Experiment 1, participants were recruited through advertisements which clearly stated as a prerequisite proficiency in the bilinguals' second language. As we shall see next, the results of the post-tests (particularly those of the grammaticality judgement test) we administered to ensure that all participants had achieved an advanced level in their L2 (Greek) showed that English-Greek bilinguals mastered agreement knowledge of both divergent (M = 98-100% of correct responses) and convergent nouns (M = 100% of correct responses).

3.6.2 Materials, Procedure, Design and Data Analysis

These were the same as in Expt. 1 except the language of subject noun phrases which is in Greek. That is, all materials employed in Expt. 2 are translation equivalents of the materials in Expt. 1. The language of instructions for the experimental procedure is also in Greek.

3.6.3 Post-Tests

3.6.3.1 Oral Translation

This was the same as in Experiment 1, except that the direction of translation was from English to Greek. (See Table 5).

	Divergent Nouns		Convergent Nouns	
Translation Direction	**English-Greek (L1-L2)**		**English-Greek (L1-L2)**	
	Sg (English)	**Pl (English)**	**Sg (English)**	**Pl (English)**
	The hair	*The trousers*	*The tree*	*The books*
	↓	↓	↓	↓
	Pl (Greek)	**Sg (Greek)**	**Sg (Greek)**	**Pl (Greek)**
	Τα μαλλιά είναι κοντά	*Το παντελόνι είναι μαύρο*	*Το δέντρο είναι πράσινο*	*Τα βιβλία είναι παλιά*
	'The hair is short'	'The trousers are black'	'The tree is green'	'The books are old'
Scores (%)				
Correct	90	84	99	95
Errors	1	0	0	2
Omissions	9	16	1	2
Misc.	0	0	0	1

Table 5. Example sentences from oral translation test and results (%) for divergent & convergent nouns. (Singular = Sg; Plural = Pl).

We conducted two-paired sample t-tests on correct translations; one for translations in singular number and one for translations in plural number. Namely, the comparison was between singular convergent and singular divergent nouns as well as between plural convergent and plural divergent nouns. The results showed that significantly more correct translations in singular number were yielded for convergent than for divergent nouns; M = 99% vs. M = 84%, respectively [$t_1(21) = 22.14$; $t_2(23) = 3.99$]. That is, English-Greek bilinguals had no difficulty translating an L1 singular noun into an L2 singular noun and producing a grammatically correct sentence, but they yielded a high number of omissions (16%) which showed a certain degree of difficulty when translating an L1 plural noun into an L2 singular noun (e.g., *The trousers* → *Το παντελόνι είναι μαύρο*; 'The trousers are black'), though without yielding any errors. The difference between convergent and divergent nouns for correct translations in plural number was also significant in the analysis by participants, whereby more correct responses were given when speakers translated an L1 plural noun into an L2 plural noun than when they translated an L1 singular noun into an L2 plural noun (e.g., *The hair* → *Τα μαλλιά είναι κοντά*); M = 95% vs. M = 90%, respectively [t_1 (21) = 4.44; $t_2(23) = 1.97$]. Thus, the results of the translation test showed English-Greek bilinguals' fluency in the L2, but also revealed their difficulty to retrieve the divergent

features of the target translation in the L2, especially when the noun in the source language was plural (*trousers*) and the target noun was singular (*παντελόνι*).

3.6.3.2 Grammaticality Judgement

This was the same as in Experiment 1, except that materials were in Greek. (See Table 6 for results, and Appendix B for materials).

Divergent Nouns

	Plural	**Singular**
	A. *Τα μαλλιά είναι κοντά* 'The hair is short'	A. *Το παντελόνι είναι μαύρα* 'The trousers is black'
	B. *Τα μαλλιά είναι κοντό* 'The hair are short'	B. *Το παντελόνι είναι μαύρο* 'The trousers are black'
Scores (%)		
Correct	98	100
Errors	2	0

Convergent Nouns

	Singular	**Plural**
	A. *Το δέντρο είναι πράσινο* 'The tree is green'	A. *Τα βιβλία είναι παλιό* 'The books is old'
	B. *Το δέντρο είναι πράσινα* 'The tree are green'	B. *Τα βιβλία είναι παλιά* 'The books are old'
Scores (%)		
Correct	100	100
Errors	0	0

Table 6. Example sentences from the grammaticality judgement task and results (%) for divergent & convergent nouns.

Two paired sample t-tests were conducted; one for correctly inflected verbs in singular number and one for correctly inflected verbs in plural number between convergent and divergent nouns. The results showed a significant difference between correctly inflected verbs after plural convergent and divergent nouns in which more correct responses were yielded in the former than in the latter; $M = 100\%$ vs. $M = 98\%$, respectively [$t_1(21) = 3.25$; $t_2(23) = 2.39$]. That is, no errors were yielded for L2 plural nouns whose number was also plural in the L1, but there were 2% errors for L2 plural nouns whose number was

singular in the L1 (e.g., **Τα μαλλιά είναι κοντό*; 'The hair is short'). There was no difference in correct responses between convergent and divergent nouns for singular number as the mean was 100% in both cases. Thus, in a very similar way to the results of Greek-English bilinguals' in Experiment 1, the results of the grammaticality judgment test in the current experiment confirmed English-Greek bilinguals' advanced level of fluency in their L2, as well as the differential degree of ease to perform a translation vs. a forced-choice test when there was number divergence across the two languages. This was clearly shown from the scores in both conditions of divergent nouns between the two tasks: more correct responses were given in the grammaticality judgement test than in the translation test for both L2 singular and L2 plural nouns whose number was different in the speakers' L1; M = 100 vs. M = 84 [$t_1(21) = 22.53$; $t_2(23) = 4.15$], and M = 98 vs. M = 90, respectively [$t_1(21) = 9.18$; $t_2(23) = 2.66$]. Importantly, Bialystok and Miller (1999) argue that participants' performance on morphosyntax may vary depending on the modality of the experimental task (e.g., oral vs. written tasks) which suggests that sometimes the observed differences between tasks (or groups) may result from a contrast between competence and performance and not competence per se.

3.6.4 Results

Percentages of responses in the four scoring categories are shown in Table 7.

Sentence Completion in L2 (Greek)

Subj.-Noun Condition			**Scores** Singular	Plural	Omissions
Conv.	Singular	(*δέντρο*) 'tree'	99	0	1
	Plural	(*βιβλία*) 'books'	0	96	4
Div.	Singular	(*παντελόνι*) 'trousers'	99	0	1
	Plural	(*μαλλιά*) 'hair'	1	96	3

Note: No miscellaneous responses were yielded

Table 7. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Divergent = Div.).

Application of the scoring criteria for singular and plural inflected verbs, omissions and miscellaneous responses are reported in Table 8.

Source of variance		**F1** (1,21)	**F2** (1,140)
		F1 value	**F2 value**
Singular	Noun-type	7.457**	.084
	Noun-number	70383.310***	21526.460***
	NT x NN	3.918	16.414***
Plural	Noun-type	1.212	4.036*
	Noun-number	131399.7***	8879.617***
	NT x NN	1.212	8.795**
Omissions	Noun-type	6.018**	1.530
	Noun-number	60.529***	9.563
	NT x NN	.741	.383
Misc.	Noun-type	5.400*	7.622**
	Noun-number	.000	.156
	NT x NN	2.100	1.400

Table 8. Results of 2-way ANOVAs with the proportions of singular and plural inflected verbs, omissions and miscellaneous responses (factors: noun-type (NT) and noun-number (NN)).

The results yielded a significant main effect of noun-type for singular number only in the analysis by participants (F_1 (1,21) = 7.46; F_2 (1,140) = .08), and in plural number only in the analysis by items (F_1 (1,21) = 1.21; F_2 (1,140) = 4.04). There was a significant main effect of noun-number for responses in singular (F_1 (1,21) = 70383.31; F_2 (1,140) = 21526.46), and for responses in plural (F_1 (1,21) = 131399.7; F_2 (1,140) = 8879.62). The interaction between noun-type and noun-number was significant only in the analysis by items for both singular and plural responses (F_1 (1,21) = 3.92; F_2 (1,140) = 16.41), and (F_1 (1,21) = 1.21; F_2 (1,140) = 8.80) respectively. Thus, both types of nouns (convergent vs. divergent) seem to have required the same processing effort from English-Greek bilinguals. Verb-agreement in plural number was more demanding than it was in singular number as more omissions were observed in the former than in the latter (see Table 7). (Figure 4 shows a comparison of proportions of correctly inflected verbs with convergent and divergent nouns).

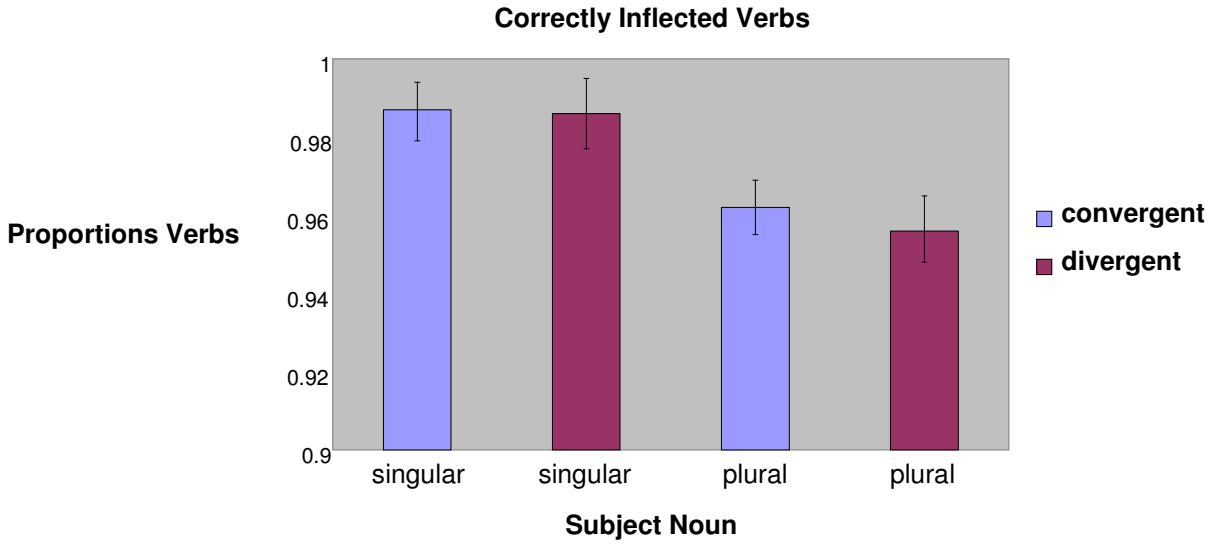

Figure 4. S-V Agreement in L2 (Greek) single-language production (monolingual mode) by English-Greek bilinguals for singular and plural correctly inflected verbs: Convergent vs. Divergent nouns.

3.7 Discussion

The findings from Experiment 2 replicated previous results from bilingual studies (e.g., Costa et al., 2003) whereby *a priori* selection of a language to speak (here, in a monolingual context) "blocked" influence of the contrastive grammar properties of the non-target language. That is, unlike Greek-English bilinguals, English-Greek bilinguals were found to be somewhat "immune" to number influence of their L1 on production in the L2. Thus, the non-target language was not found to exert influence on production in the target language. What could account for the difference of influence of the non-target language between Greek (Expt. 1) and English bilinguals (Expt. 2)?

We might hypothesize that it was not the agreement mechanisms that were different across the two bilingual groups, but the links between number representation and language. That is, Greek-English bilinguals were found to be prone to plural number influence from the L1 (*μαλλιά*) after L2 singular subject nouns (*hair*). This can be explained by arguing that in Greek, grammatical number goes hand in hand with notional number most of the time (see following experiments for more information on notional

number). Consequently, the Greek translation equivalent for 'hair' would be double-marked (morphologically and notionally) as plural for Greek-English bilinguals, rendering weaker the "resistance" of the L2 agreement system against plural interference from the activated L1 lemma.

On the other hand, mapping of word-forms to concepts is not always one-to-one for English-Greek bilinguals. For instance, bipartite nouns have been reported to be considered as singletons despite their plural morphology (Bock et al., 2001). In Experiment 2, in L2 singular divergent noun phrases where the majority of nouns were bipartites (e.g., *παντελόνι*; 'trousers'), we did not find any occurrence of influence of the morphologically plural English translation equivalent (*trousers*), possibly because the L1 (English) morphological features without reinforcement of matching conceptual features were not strong enough to interfere in the process of agreement implementation in a strictly L2 discourse environment (see also Vigliocco & Franck, 1999; 2001, for a similar account on gender agreement).

Another possibility why English-Greek bilinguals were not influenced by the underlying number of the L1 might be that they acquired better skills than Greek-English bilinguals in inhibiting the non-response language. That is, because the English language is morphophonologically less varied than the Greek language, this entails that there are fewer sources that require attention control, therefore fewer possibilities of those sources creating interference. Thus, it might be the case that because of the grammatical features of English in contrast to Greek, L1 activation was not strong enough to interfere with the L2. However, more research is needed to confirm this hypothesis, since so far there have been no attempts to address this issue directly.

A relevant point to L1 and L2 language properties which is also worth mentioning is the fact that the Greek materials, unlike the English materials, were redundantly marked for gender and number on the determiner and on the subject noun. That is, for the English NPs (Expt. 1), the determiner "the" was used throughout (e.g., *The hair*/*The trousers*/*The tree*/*The books*), but for the Greek NPs (Expt. 2), determiners were also marked for gender and number (e.g., *Τα μαλλιά*; the-N, P hair-N, P/*Το παντελόνι*; the-N, S trousers-N, S/*Το δέντρο*; the-N, S tree-N, S/*Τα βιβλία*; the-N, P books-N, P). Thus, one might argue that the Greek materials, having agreement within the NP, could interact with the computation of agreement from the subject to the verb phrase. That is, agreement could have a greater effect in Greek than in

English because of the extra marking. Assuming that was the case, we could expect two possibilities in English-Greek bilinguals' performance: either a lower rate of agreement errors due to the reinforced marked number of the NP constituents, or a higher rate of agreement errors due to the demanding processing in the target language (Greek). The results that we obtained seem to support the former account since there were no agreement errors in either the convergent or the divergent subject noun condition. One might also argue that participants would be able to infer the number and gender of a Greek NP from the morphological marking of the determiner alone without processing the end of the subject noun. However, the difference in error rates between convergent and divergent noun sentence completions in the following bilingual mode experiments shows that subject nouns were processed lexically. Moreover, Eberhard (1997) argues that because number is typically a property of nouns, a number feature that comes from a subject noun should be more highly activated than a number feature that comes from a determiner.

Monolingual studies on the effects of marked vs. unmarked determiners have provided contrasting results. In Vigliocco et al. (1995), the number of agreement markers in Italian was not found to have influenced error rates in an NP, since ambiguous subject nouns induced more agreement errors than marked subject nouns despite the fact that ambiguous subject nouns' determiners remained unambiguously marked for number and gender. In the same line, Meyer and Bock (1999) did not find an effect of overtly marked vs. convertly marked determiners on error rates in formulating demonstrative pronouns in Dutch, even though subject nouns were not marked. On the other hand, Hartsuiker et al. (2003) reported effects of marked vs. unmarked Dutch and German determiners on agreement computation, whereby more errors were yielded when there was number ambiguity of the subject nouns due to unmarked determiners than when not.

Another issue that relates to the comparison between the two bilingual groups and needs to be discussed briefly is their difference in age. English-Greek bilinguals were substantially older than the ones in the Greek-English group (mean age 50 years vs. 25 years, respectively). Reports from monolingual studies show that executive processes, such as response suppression, inhibitory control, and task-switching tend to decline with normal aging (e.g., Daniels, Toth, & Jacoby, 2006), thus one might expect that the above difference in age would confound English-Greek bilinguals' performance. That is,

the younger group would be expected to outperform the older group in the on-line task of sentence completion. However, this should not necessarily be the case, because evidence from bilingual studies shows that bilingualism helps to offset age-related losses in certain executive processes (e.g., Bialystok, Craik, & Ryan, 2006). In addition, and most crucially, the findings from the older English-Greek bilinguals' performance in Experiment 2 showed that not only did they not make more errors than the younger Greek-English bilingual group in Experiment 1, but they actually yielded no evidence of influence of the non-target language when completing sentences in the target language during the monolingual mode. Moreover, as we shall see in the following bilingual mode experiments, the younger group of Greek-English bilinguals shows more evidence of influence of the non-target language overall.

To summarize, evidence for number influence of the non-target language for Greek-English bilinguals but not for English-Greek bilinguals might be due to the rich inflectional system of the Greek language and to a pre-existing language asymmetry of mapping lexical items to concepts, thus making participants be influenced by different segments of information from each language system while performing a language task such as the one we used here.

3.8 Chapter Summary

In this chapter we reported two experiments on Greek-English and English-Greek fluent bilinguals to examine language interaction at sentential level and the influence of the representation of divergent nouns (i.e., nouns whose number differed across the two languages) on the construction of subject-verb agreement in comparison to convergent nouns (i.e., nouns whose number was the same across languages).

In Experiments 1 and 2, Greek-English and English-Greek bilinguals respectively were provided with divergent and convergent subject nouns and completed sentences entirely in their L2 (monolingual mode). As predicted, both groups of bilinguals performed nearly perfectly in conditions with convergent nouns since their number was shared between the two languages. English-Greek bilinguals showed somewhat processing costs when they produced sentences in plural number, but that was normal as the

inflectional system of the Greek language is rich, and S-V agreement in plural number is complex to construct due to the variety of plural markers.

Following divergent subject nouns, for Greek-English bilinguals there was significant influence of the L1 in V-agreement after an L2 singular subject noun whose translation equivalent was plural in the L1 (e.g., **The hair are short*). For English-Greek bilinguals, L1 number influence was not significant and the negligible pattern of influence that was found was only after L2 plural nouns whose translation equivalent was singular in the L1 (e.g., **Τα μαλλιά είναι κοντό*; 'The hair is short'). We account this latter finding to the extra processing difficulty the divergence of this type of nouns created for English-Greek bilinguals that led them to yield a minimal amount of agreement errors. (We discuss this further below). (See Figure 5 for a comparison of proportions of correctly inflected verbs between Greek-English bilinguals' responses and English-Greek bilinguals' responses, and Table 9 for a summary of the two bilingual groups' performance on L2 sentence production in the monolingual mode. In Table 9, we report the percentages of correct S-V agreement, and in brackets the percentages of L1 number interference (errors)).

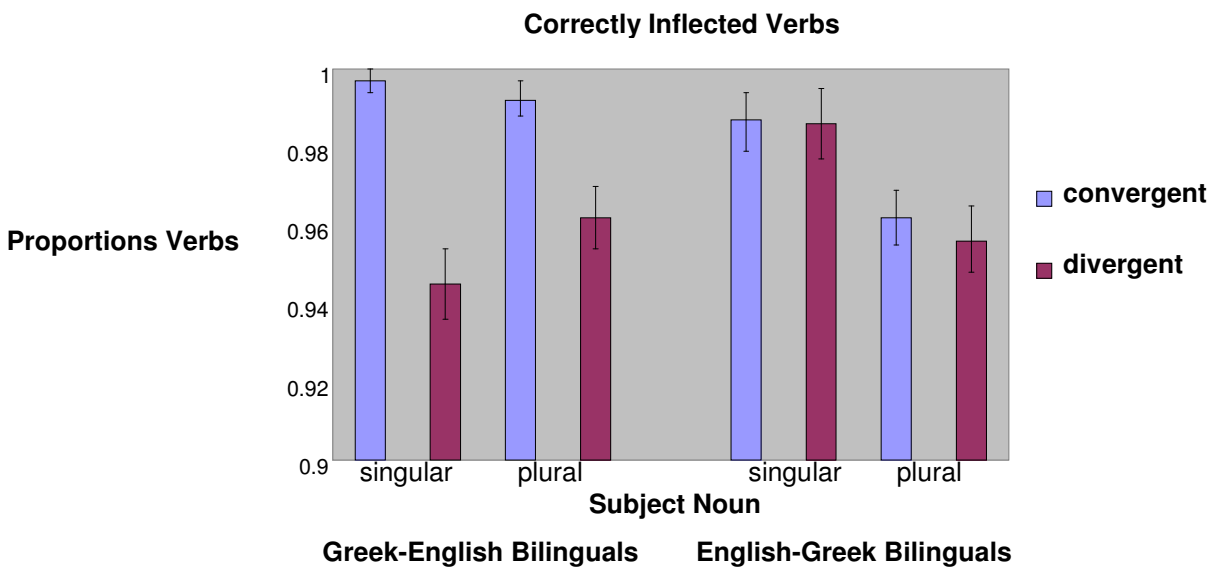

Figure 5. Comparison of correctly inflected verbs between Greek-English (Expt. 1) and English-Greek (Expt. 2) bilinguals in the monolingual mode.

Greek-English Bilinguals				English-Greek Bilinguals			
Convergent	Singular	tree	100 (0)	**Convergent**	Singular	δέντρο	99 (0)
	Plural	books	99 (0)		Plural	βιβλία	96 (0)
Divergent	Singular	hair	95 (4)	**Divergent**	Plural	μαλλιά	96 (1)
	Plural	trousers	96 (1)		Singular	παντελόνι	99 (0)

Table 9. Greek-English and English-Greek bilinguals' performance on L2 sentence-completion in the monolingual mode. Percentages of correct S-V agreement and in brackets percentages of errors.

CHAPTER 4

Sentence Production in the Bilingual Mode: Verb-Agreement

4.0 Chapter Overview

In Chapter 3 we examined the effects of number divergence on S-V agreement when bilinguals produced utterances entirely in one language (L2), that is, in the monolingual mode. In the present chapter we further investigate whether the bilingual mode might enhance L1 influence (be it syntactic or semantic) that we observed previously with Greek-English bilinguals, and whether language alternation is strong enough to overcome English-Greek bilinguals' resistance to the influences of their native language which should be now equally activated with the L2.

In Experiment 3, Greek-English bilinguals complete sentences with convergent and divergent subject nouns in both their languages during intra-sentential code-switched production. In Experiments 4 and 5, Greek-English and English-Greek bilinguals respectively, apart from code-switching, also produce single-language utterances in the same session. Thus, we can gain insight into some of the variables that modify code-switched production as well as test directly the effects of the bilingual mode on single-language utterances.

4.1 Language-Switching Tasks and Cognitive Control

In section 2.3.1 on *Word Selection and Language Control*, we discussed various views on how bilinguals are able to communicate in the monolingual and bilingual modes and how they manage to control the non-response language by inhibiting it (e.g., Green, 1998), by lowering the level of activation of the non-response in comparison to the response language (e.g., La Heij, 2005), or by intentionally selecting lexical items only from the intended language (e.g., Costa & Caramazza, 1999). We also stressed the importance of cognitive resources to successful language processing and control of output. For example, Michael and Gollan (2005) claim that working memory may act as a suppressing (or else, inhibiting) mechanism that regulates the amount of information that is necessary for the speech plan, thus

decreasing language interference by preventing co-activated non-intended candidates to enter the competition for selection.

Regarding processing limitations, the *Resource Allocation Theory* (Norman & Bobrow, 1975) assumes that for the execution of a task which requires cognitive processing, certain resources such as *processing effort*, *memory capacity*, and *communication channels* (i.e., information processing areas) must be in place. The authors argue that task performance may be limited because there is not enough information to cope with the processing of the data and/or insufficient resources to process the data. Alternatively, if the processor has enough information and ample resources, it can proceed to successful data processing (*data-limited processing*) and improved performance (*resource-limited processing*). To illustrate how this distinction applies to our experimental tasks for *data processing*, participants need to have the knowledge of how to compute agreement in the L2 and be able to distinguish between convergent and divergent nouns and their language properties. For *resource processing*, they need to be able to control the activation and inhibition of their languages, have high memory capacity, and be able to produce an utterance within the required time-limit.

Within this framework, it is also assumed that certain processes are either data- or resource-limited, but others may change from one to the other depending on resource allocation changes. In other words, performance on a task is positively related to the amount of resources available to it. Thus, variation in the quality of data input and resource allocation may affect task performance accordingly. For example, in a task such as single-language sentence completion with divergent and convergent nouns, a bilingual has to inhibit the non-response language, retrieve the correct representation for the subject noun (i.e., its grammatical and syntactic properties), and compute the speech plan in the response language by applying the grammar rules of that language system. However, in a code-switching task, the cognitive load increases as there is strong competition between the linguistic elements of each activated language system which, in combination with the restricted response time, renders the task more difficult, therefore more resource consuming and more likely to impaired performance.

The importance of "resource", particularly of resource replenishment, is also considered in the Inhibitory Control Model (IC) proposed by Green (1986, 1998) in which language control and output are

regulated, amongst others, by the availability of resources which are responsible for language suppression (or else, *inhibition*), language activation, structure construction or modification, and task performance (e.g., single-language or code-switching tasks). The author argues that resources are increasingly consumed during both highly demanding linguistic tasks (e.g., translation) and non-linguistic circumstances (e.g., stressful situations), and emphasizes the importance of balanced regulatory means (resources) for successful task performance. If there are not enough resources to ensure proper cognitive functioning, it is most likely that errors will occur.

We also discussed evidence of effects of resource limitations on S-V agreement performance in section 2.5.1.2 *Attraction, Markedness and S-V Agreement*, particularly in the study of Hartsuiker and Barkhuysen (2006) which showed that the task of number assignment from message to syntax and number conflict during syntactic integration are vulnerable to resource constraints (e.g., memory span and load) (see also Hartsuiker, et al., 1999, for consequences of resource limitations on S-V agreement with normal speakers and Broca's aphasics). In the same section, we also reported the findings from the study of Fayol et al. (1994) which showed disrupted agreement under working memory overload in which speakers had to perform simultaneously on two cognitive demanding tasks (graphic transcription of orally presented sentences and word-recall or click-counting). The authors concluded that when cognitive resources are limited, feature checking and feature control in agreement suffer, resulting in agreement errors.

So far, there have been no attempts to study verb-agreement in bilingual production where the effects of the bilingual mode (including code-switching) have been tested empirically. Since a considerable amount of information on rapid alternation between languages whereby linguistic material from both of them is creatively used comes mainly from sociolinguistic and linguistic approaches (e.g., Myers-Scotton, 2006), more research is needed to shed light to the operations of variables such as the ones we mentioned above on code-switching and cognitive control. Next we report two studies that are relevant to the present discussion and aims of this chapter.

In their study, Meuter and Allport (1999) examined the effects of language switching on numeral naming performance. French, German, Italian, Portuguese, and Spanish fluent bilinguals, whose first or

second language was English, were asked to name numerals in either of their languages randomly. The authors sought to explore whether language selection in bilinguals resembles other control tasks not necessarily involving language, or whether it engages cognitive processes that are especially employed for language control. Following the *Task Set Inertia Hypothesis*, they predicted that switching from the L2 to the L1 would be more difficult and thus take more time than switching from the L1 to the L2 for two reasons: first, because of the influence of the preceding task set that could spill over the next trial (e.g., Allport, Styles, & Hsieh, 1994), and second, and more importantly, because more effort would be required to suppress the dominant task (naming in the L1) in order to perform the weaker task (naming in the L2). Indeed, the results confirmed the hypothesis for asymmetrical switching costs due to a difficulty of disengagement from the preceding language set, and provided support that language switching employs similar processes to other control tasks (but see Finkbeiner, Almeida, Janssen, & Caramazza, 2006).

In a more recent study, Costa and Santesteban (2004) explored language inhibition in a picture-naming switching task as a function of proficiency in the L2. In a series of experiments with Spanish-Catalan and Korean-Spanish bilinguals, the experimenters manipulated bilinguals' proficiency in the L2 (advanced vs. low) and the type of trial (switch vs. non-switch). The results of Experiment 1 with bilinguals of low proficiency in the L2 replicated Meuter and Allport's (1999) findings whereby the magnitude of the switching cost for L1 was larger than for L2. Interestingly, the results of Experiments 2 and 3 with advanced bilinguals showed symmetrical switching costs and faster response time in L2 than in L1, which were replicated even when the same proficient bilinguals performed the switching task between their L1 and L3 (Experiment 4). Based on these striking findings, the authors argued that although language inhibition mechanisms may come into play for L2 learners when they have to produce utterances while alternating between a strong and a weak language, this is not the case for proficient bilinguals; for the latter appear to be able to apply a different language selection mechanism which considers only lexical items from the intended language regardless of whether that language is their dominant or less dominant language (e.g., L3) (see also Costa et al., 2006, where age of language acquisition and language similarity are also manipulated).

4.2 Rationale and Predictions

The present study is the first to investigate agreement in elicited code-switched production under controlled experimental conditions. The purpose of Experiment 3 is to test whether bilinguals who report frequent, intentional switches of spoken language as an everyday occurrence are able to do so in the laboratory in intra-sentential CS (e.g., Τα πόδια *will probably take a while though to heal*; 'The legs will probably take a while though to heal', quoted in an email discussion between two Greek-English fluent bilinguals). By using the methodology that we describe below, we can gain insight into the patterns of agreement during CS and the effects each switch direction has on agreement computation with convergent and divergent subject nouns. The present experiment also sets the stage for the next experiments in which the same materials are used but the focus is transferred to other critical conditions. We also report a norming study post-test.

4.3 Method

4.3.1 Participants

These were sixteen Greek-English fluent bilinguals, who were native speakers of Greek and spoke English as a second language. They were all postgraduate students at the University of Edinburgh and had studied English through private tuition which involved grammar, listening and reading comprehension as well as oral practice for a mean of 8 years (SD = 1.1) before moving to the UK. Their average age was 28 years (SD = 1.2). None of them had participated in Experiment 1, but the same recruiting procedure as in Expt. 1 was applied to ensure bilinguals' high level of fluency in the L2. All participants were paid for participating.

4.3.2 Materials

These were two counterbalanced 144-item lists, consisting of *The* plus a noun for English noun phrases, and their translations for Greek noun phrases, each of which contained one version of divergent

nouns and one version of convergent nouns which occurred only once in the list. There were 48 divergent nouns and each was seen in one of its two language versions in each list, so that the following four intra-sentential CS conditions of 12 divergent nouns each were formed: English singular subject noun (Greek plural translation equivalent), Greek plural subject noun (English singular translation equivalent), English plural subject noun (Greek singular translation equivalent), and Greek singular subject noun (English plural translation equivalent). Note that the Greek translation equivalent to an English plural divergent noun is grammatically singular (e.g., *παντελόνι*; 'trousers' in Greek), but can also bear a plural marking if the noun is considered to refer to many pairs of trousers (e.g., *παντελόνια*). For the purposes of our study, we only included the singular version of these nouns to counterbalance the conditions of singular and plural number across the two languages.

In addition to the divergent nouns there were 96 convergent nouns, that is, nouns whose morphological number was the same between the two languages; 48 of which (24 in singular and 24 in plural) formed four single-language conditions (English singular subject noun, English plural subject noun, Greek singular subject noun, and Greek plural subject noun) of 12 convergent nouns each. In those conditions, the verb should be produced in the same language as the preamble. The other 48 convergent nouns (24 in singular and 24 in plural) formed four intra-sentential CS conditions of 12 convergent nouns each in the following switches: English-Greek singular, English-Greek plural, Greek-English singular and Greek-English plural. All English items paralleled the Greek. The order of presentation was individually randomised across and within lists and there were at least two convergent nouns that preceded or followed any divergent noun. (Examples of preambles are given in Table 10. The complete list of the materials is reported in Appendix A).

4.3.3 Post-Test

4.3.3.1 Norming Study

A notional-number norm study (Bock et al., 2001) was carried out six months after Experiment 2 had taken place on the same Greek-English bilinguals for all the items used in the experiment. Four counterbalanced lists were constructed of 96 items. There were 48 divergent nouns each, half of which were seen in English and half of which were seen in Greek. An additional 48 convergent nouns were

included, 24 in singular and 24 in plural. From each group of 24 convergent nouns, 12 were seen in Greek and 12 were seen in English (see Appendix C). Participants were asked to rate on a 7-point scale the extent to which, when they read each noun from that list, they thought of it as being "one thing" or "more than one thing". They were asked to give a 1 if the word was considered as being "one thing" and a 7 if it was considered to be "more than one thing" (see Table 10).

		Mean Notional Number (1 = one thing, 7 = more than one thing)			
Subject Noun Condition		**Item in English**		**Item in Greek**	
Convergent					
	Sg	*The tree*	1.00	Sg *Το δέντρο*	1.00
	Pl	*The books*	5.83	Pl *Τα βιβλία*	5.79
Divergent					
	Sg	*The hair*	2.83	Pl *Τα μαλλιά*	3.58
	Pl	*The trousers*	3.21	Sg *Το παντελόνι*	1.21

Table 10. Mean notional number for all items by Greek-English bilinguals. (Singular = Sg; Plural = Pl).

We performed a three-way ANOVA with the factors language (English vs. Greek), noun-number (singular vs. plural), and noun-type (convergent vs. divergent) on participants' mean-ratings. All factors were within-participants. The language factor was within-items, and noun-number and noun-type factors were between-items. Two analyses of variance, one for participants (F1) and one for items (F2) were carried out. The results yielded significant main effects of language (F_1 (1,15) = 317.85; F_2 (1,92) = 10.53), noun-number (F_1 (1,15) = 89456.10; F_2 (1,92) = 153.344), and noun-type (F_1 (1,15) = 2596.10; F_2 (1,92) = 20.555). The two-way interactions between language and noun-number (F_1 (1,15) = 1291.50; F_2 (1,92) = 49.19), language and noun-type (F_1 (1,15) = 615.00; F_2 (1,92) = 9.22), and noun-number and noun-type (F_1 (1,15) = 8166.50; F_2 (1,92) = 356.43) were also significant. Finally, the three-way interaction between language, noun-number and noun-type was significant (F_1 (1,15) = 1257.28; F_2 (1,92) = 46.30), meaning that the language x noun-number interaction was significantly different in convergent and divergent nouns. Thus, the mean ratings for singular and plural convergent nouns in

English and in Greek were quite similar across languages but, as expected, differed across number. The mean ratings for singular and plural divergent nouns showed that English singular divergent nouns (*hair*, being morphologically plural in Greek) were considered more plural than English or Greek singular convergent nouns (*tree*), yet not as plural as English or Greek plural convergent nouns (*books*). English plural divergent nouns (*trousers*, having either a singular or plural morphology in Greek depending on the context) were thought as more plural than English or Greek singular convergent nouns (*tree*), but less plural than English or Greek plural convergent nouns (*books*). Greek singular divergent nouns (*παντελόνι*; 'trousers') were considered as singular as English or Greek singular convergent nouns (*tree*), whereas Greek plural divergent nouns (*μαλλιά*; 'hair') were considered more plural than English or Greek singular convergent nouns (*tree*), but less plural than English or Greek plural convergent nouns (*books*).

4.3.4 Procedure

Participants were tested individually in a quiet room. Prior to performing the actual task they were trained on an 8-filler session. None of the fillers was included in the experiment. After the end of the training session, the actual experiment would start with instructions in English, displayed on a computer screen. Participants were told that they would see the beginning of a sentence, displayed within a blue or red coloured square at the centre of the screen that they had to read aloud, and continue on with a completion to make a single sentence in the appropriate language depending on the colour of the square; a blue square would be equivalent to 'complete in Greek', whereas a red square would be equivalent to 'complete in English'. Finally, speakers were asked to perform as fast as possible and press the spacebar for the experiment to start. A fixation cross was always shown at the centre of the computer screen for 1500ms prior to target preamble presentation whose display lasted for 1800ms. Each session lasted about ten minutes. All answers were recorded and transcribed for further analysis.

4.3.5 Scoring

This was the same as in Experiments 1 and 2.

4.3.6 Design and Data Analysis

A 2 source-language (Greek vs. English) x 2 source-language number (singular vs. plural) x 2 language-task (single-language vs. CS) x 2 source-language noun type (convergent vs. divergent) design was created. All four factors were within-participants. The source-language factor was within-items, and the language-task, source-language number and noun-type factors were between-items. Responses in singular, in plural, omissions and miscellaneous responses constituted the dependent variables. We conducted two sets of analyses for each dependent measure of each type of nouns: one for convergent nouns comparing single-language and CS conditions, and one for divergent nouns comparing divergent nouns with convergent nouns of the corresponding CS conditions, as divergent items were only manipulated in CS conditions (i.e., the language-task factor was not included). Two analyses of variance with the proportions of the dependent ariables, one for participants ($F1$) and one for items ($F2$) were carried out.

4.3.7 Results

Percentages of responses in the three scoring categories for single-language and CS conditions are shown in Table 11.

Single-Language Condition

		Language of Noun-Phrase					
		Greek (L1)			**English (L2)**		
Subj.-Noun Condition		**Scores in L1**			**Scores in L2**		
		Singular	Plural	Omissions	Singular	Plural	Omissions
Conv.	Sg (δέντρο)	96	0	4	94	1	5
	Pl (βιβλία)	0	97	3	0	96	4
Div.	Sg	-	-	-	-	-	-
	Pl	-	-	-	-	-	-

CS Condition

	Language of Noun-Phrase					
	Greek (L1)			**English (L2)**		
Subj.-Noun Condition	**Scores in L2**			**Scores in L1**		
	Singular	Plural	Omissions	Singular	Plural	Omissions
Conv. Sg (τσέπη)	92	0	8	91	1	8
Conv. Pl (κήποι)	0	94	6	0	91	9
Div. Sg (παντελόνι)	89	0	11	24	55	21
Div. Pl (μαλλιά)	4	90	6	9	62	29

Table 11. Percentages of responses in three scoring categories by subject noun condition. (Convergent = Conv.; Divergent = Div.; Singular = Sg; Plural = Pl).

Application of the scoring criteria for singular and plural inflected verbs, omissions and miscellaneous responses for convergent nouns are reported in Table 12 and for divergent nouns in Table 13.

Source of variance		**F1** (1,15)	**F2** (1,92)
		F1 value	**F2 value**
Singular	Source-language	.808	.598
	Source-language number	4485.418***	11043.723***
	Language-task	5.140*	3.016
	SL x SLN	.808	.598
	SL x LT	.045	.504
	SLN x LT	5.140*	3.016
	SL x SLN x LT	.045	.504
Plural	Source-language	.439	.273
	Source-language number	4879.238***	9959.784***
	Language-task	3.271	3.649
	SL x SLN	1.909	.273
	SL x LT	.144	2.459
	SLN x LT	5.153*	3.649
	SL x SLN x LT	.338	2.459

Omissions	Source-language	.950	.097
	Source-language number	.408	.348
	Language-task	6.245*	6.278*
	SL x SLN	.303	.920
	SL x LT	.006	2.745
	SLN x LT	.016	.037
	SL x SLN x LT	.460	.082

Note: No miscellaneous responses were yielded

Table 12. Results of 3-way ANOVAs with the proportions of singular and plural inflected verbs, omissions and miscellaneous responses for convergent nouns (factors: source-language (SL), source-language number (SLN), and language-task (LT)).

Source of variance		**F1** (1,15)	**F2** (1,92)
		F1 value	**F2 value**
Singular	Source-language	212.166***	59.899***
	Source-language number	2143.837***	703.737***
	Noun-type	97.118***	174.055***
	SL x SLN	181.364***	29.995***
	SL x NT	46.777***	60.227***
	SLN x NT	194.505***	239.198***
	SL x SLN x NT	57.159***	30.228***
Plural	Source-language	11.687***	82.928***
	Source-language number	3102.625***	459.165***
	Noun-type	5.362*	42.645***
	SL x SLN	168.541***	17.492***
	SL x NT	13.073***	90.925***
	SLN x NT	256.490***	205.528***
	SL x SLN x NT	83.441***	14.088***
Omissions	Source-language	22.112***	9.840***
	Source-language number	.029	.959
	Noun-type	14.908***	21.632***
	SL x SLN	4.571	.299
	SL x NT	15.788***	13.891***
	SLN x NT	1.063	1.403
	SL x SLN x NT	1.459	1.195

Note: No miscellaneous responses were yielded

Table 13. Results of 3-way ANOVAs with the proportions of singular and plural inflected verbs, omissions and miscellaneous responses for divergent nouns (factors: source-language (SL), source-language number (SLN), and noun-type (NT)).

4.3.7.1 Results of Analysis on Convergent Nouns

Moreover, we conducted t-tests to make the following comparisons for convergent subject nouns: (a) across languages within each language task, and (b) across language tasks within each language. Across languages, for the single-language task, there was no significant difference in correct responses either in singular (e.g., *Το δέντρο είναι πράσινο/The tree is green*) or in plural number (e.g., *Τα βιβλία είναι παλιά/The books are old*); M = 96% vs. M = 94% [$t_1(15) = 1.46$; $t_2(23) = 1.04$], and M = 97% vs. M = 96%, respectively [$t_1(15) = .49$; $t_2(23) = 1.00$]. The same was true for the CS task in both switch directions (e.g., Η τσέπη *is empty*/The pocket *είναι άδεια*); M = 92% vs. M = 91% [$t_1(15) = .26$; $t_2(23) = .05$], and (e.g., Οι κήποι *are beautiful*/The gardens *είναι όμορφοι*); M = 94% vs. M = 91%, respectively [$t_1(15) = .90$; $t_2(23) = 1.23$].

Comparing across language tasks, the difference between single-language and CS for correct responses when the source-noun language was the L1 was not significant for singular number (e.g., *Το δέντρο είναι πράσινο* vs. Η τσέπη *is empty*); M = 96% vs. M = 92% [$t_1(15) = 1.33$; $t_2(23) = 2.19$] or for plural number in the analysis by participants (e.g., *Τα βιβλία είναι παλιά* vs. Οι κήποι *are beautiful*); M = 97% vs. M = 94% [$t_1(15) = 1.05$; $t_2(23) = 2.32$]. For correct responses when the source-noun language was the L2, the difference between single-language and CS was not significant either for singular number (e.g., *The tree is green* vs. The pocket *είναι άδεια*); M = 94% vs. M = 91% [$t_1(15) = 1.15$; $t_2(23) = .82$], or for plural number (e.g., *The books are old* vs. The gardens *είναι όμορφοι*); M = 96% vs. M = 91% [$t_1(15) = 1.59$; $t_2(23) = 1.04$].

4.3.7.2 Results of Analysis on Divergent Nouns

We also conducted t-tests to examine speakers' responses with divergent nouns in CS: (a) within each switch direction, and (b) in comparison to CS with convergent nouns. Regarding the analysis of divergent nouns in L1-L2 direction, the results of both singular and plural subject noun completions showed that the produced verb tended to acquire the number specification of the L1 subject noun. Thus, after L1 singular nouns more singular than plural inflected verbs were produced in L2 (e.g., Το παντελόνι *is black*; 'The trousers is black'); M = 89% vs. M = 0% [$t_1(15) = 31.90$; $t_2(23) = 25.55$], and after L1 plural

nouns more plural than singular inflected verbs were produced in L2 (e.g., Τα μαλλιά *are short*; 'The hair are short'); *M* = 90% vs. *M* = 4% [$t_1(15) = 24.82$; $t_2(23) = 24.85$]. In L2-L1 direction, after L2 singular nouns more plural than singular inflected verbs were produced in L1 (e.g., The hair *είναι κοντά*; 'The hair are short'); *M* = 55% vs. *M* = 24% [$t_1(15) = 3.45$; $t_2(23) = 3.10$], and after L2 plural nouns more plural than singular inflected verbs were produced in L1 (e.g., The trousers *είναι μαύρα*; 'The trousers are black'); *M* = 62% vs. *M* = 9% [$t_1(15) = 16.52$; $t_2(23) = 4.88$]. (We discuss this finding in the following section).

The results of the comparison between CS with divergent nouns and CS with convergent nouns in L1-L2 direction showed that the difference in responses after singular or plural subject nouns was not significant. That is, regardless of noun-type, the verb acquired the number of the L1 subject noun both following singular subject nouns (e.g., *τσέπη* vs. *παντελόνι*); *M* = 92% vs. *M* = 89% [$t_1(15) = 1.02$; $t_2(23) = 1.92$], and plural subject nouns (e.g., *κήποι* vs. *μαλλιά*); *M* = 94% vs. *M* = 90% [$t_1(15) = 1.23$; $t_2(23) = 2.06$]. In L2-L1 direction, the difference in responses between divergent and convergent nouns was significant for both numbers. That is, more responses were given in singular following a singular convergent than a singular divergent noun (e.g., *pocket* vs. *hair*); *M* = 91% vs. *M* = 24% [$t_1(15) = 11.31$; $t_2(23) = 12.26$], and more responses were given in plural following a plural convergent than a plural divergent noun (e.g., *gardens* vs. *trousers*); *M* = 91% vs. *M* = 62% [$t_1(15) = 7.00$; $t_2(23) = 4.51$].

4.4 Discussion

The findings from convergent nouns confirmed the hypothesis that S-V agreement should be implemented unimpeded when the nominal subject had the same number in the two languages. The only factor that could have constrained agreement computation in the current experiment (especially with divergent nouns) was time pressure posed by the experimental procedure which required participants to interpret the language cue and complete the sentence at the same time. This concern was dealt in the following experiments.

The responses from divergent nouns in CS yielded three interesting findings: first, overall, subject noun in bilinguals' native language (i.e., Greek) controlled verb-agreement, not only when it was the

language of the NP (L1-L2 direction), but also when it was the target language (L2-L1 direction). In particular, L2-L1 direction showed to be more demanding (more omissions were yielded in L2-L1 than in L1-L2 direction) and more sensitive to feature "conflict" between the grammatical idiosyncracies of the two language systems. In the same line, in the study of Meuter and Allport (1999) that we presented in the introduction of this chapter, although the number of errors was very small, twice as many errors were committed when switching from L2 to L1 as vice versa.

Second, English divergent plural nouns (e.g., *trousers*) which are rather ambiguous for Greek-English bilinguals if not put in context (for they can bear either a plural or a singular marker in Greek), when they were seen in English (i.e., *trousers*, bearing a plural marker) were considered plural, but when they were seen in Greek (i.e., *παντελόνι*, bearing a singular inflection) were considered singular, yielding plural and singular verb-production respectively. Thus, we argue that possible ambiguity of the number of the subject noun might have led the Greeks to rely on a superficial trace (i.e., plural marking) to guide verb-agreement. This speculation is also supported by the norms we collected for these nouns (see Table 10) and is in accordance with Grosjean's (1997a) claim that lemma selection in bilingual production may be directed by conceptual and pragmatic variables.

Third, and more importantly, in L2-L1 direction, a considerable number of plural-inflected verbs were produced after L2 singular divergent subject nouns. That is, in more than half of the responses the verb produced in the L1 was in plural as if it had agreed with the L1 plural counterpart. This finding not only confirms the prediction that the effects of contrastive number for English singular divergent-nouns that we observed in single-language completion in Experiment 1 should increase in code-switched speech, but also provides support for a markedness account in Greek-English bilinguals whereby a singular subject-noun in one language becomes more vulnerable when it competes with its plural translation in the other language during sentence processing. In addition, the nature of the task and the control skills of the speakers may have influenced sentence completion in this direction (van Heuven & Dijkstra, 1998).

EXPERIMENT 4: Sentence-Completion in Mixed-Language Production by Greek-English Bilinguals

4.5 Rationale and Predictions

Experiment 4 adds single-language conditions in the L1 as well as code-switching conditions to test our prediction that L1 influence in L2 production should be exaggerated in a bilingual mode setting where both languages would have equal share of activation and participation. Thus, apart from the single-language conditions with convergent and divergent nouns used in Experiment 1, in which the verb of the noun phrase should be produced in the same language (English), we also added corresponding single-language conditions in the L1 (Greek), and code-switching conditions with convergent and divergent nouns where the verb should be produced in the other language than the language of the noun phrase (Greek or English). We also report three post-tests (i.e., a translation test, a grammaticality forced-choice test, and a notional number test).

4.6 Method

4.6.1. Participants

Twenty Greek-English fluent bilinguals who were native speakers of Greek and spoke English as a second language were paid to participate. They were all postgraduate students at the University of Edinburgh and had studied English through private tuition which involved grammar, listening and reading comprehension, as well as oral practice for a mean of 8 years (SD = .89) before moving to the UK. Their average age was 27 years (SD = 1.00). None of them had participated in the previous experiments. As we shall see below, Greek-English bilinguals' nearly perfect performance on both L2 proficiency tests (particularly in the grammaticality judgement task, M = 95-99% of correct responses for divergent nouns and M = 100% of correct responses for convergent nouns) demonstrated that participants possessed the relevant grammatical knowledge of agreement (i.e., which form – singular or plural – was correct).

A control group of English monolinguals (average age 47 years; SD = 2.8) living in Edinburgh was also tested on the grammaticality judgement task and participated in the norming study (see next section). The findings from the comparison between the performance of English monolinguals on S-V agreement

and the performance of Greek-English bilinguals on the same grammatical features corroborated the hypothesis that any differences observed in agreement computation between convergent and divergent nouns by Greek-English bilinguals were due to bilingualism and not to the materials, for English monolinguals did not differentiate between convergent and divergent noun agreement, and yielded almost 100% correct responses in both cases. (The scores of the performance of English monolinguals on the grammaticality judgement task are reported in Table 15 along with the scores of Greek-English bilinguals in their L2).

4.6.2 Materials

These were two counterbalanced 192-item lists, consisting of *The* plus a noun for English noun phrases, and their translations for Greek noun phrases. There were 96 divergent nouns and 96 convergent nouns. Of the 96 divergent nouns, 48 (24 in singular and 24 in plural) formed four single-language conditions of 12 subject nouns each. In these conditions the verb should be produced in the same language as the subject noun. The remaining 48 divergent nouns (24 in singular and 24 in plural) formed four CS conditions of 12 items each. In these conditions the verb should be produced in the other language of the language of the subject noun. Each item was seen in one of its two language versions in each list, so that the following conditions were formed: English singular subject noun (Greek plural translation equivalent), Greek plural subject noun (English singular translation equivalent), English plural subject noun (Greek singular translation equivalent), and Greek singular subject noun (English plural translation equivalent).

Of the 96 convergent nouns, 48 (24 in singular and 24 in plural) formed four single-language conditions of 12 subject nouns each: English singular subject noun, English plural subject noun, Greek singular subject noun, and Greek plural subject noun. In these conditions, the verb should be produced in the same language as the subject noun. The remaining 48 convergent nouns (24 in singular and 24 in plural) formed four CS conditions of 12 subject nouns each in the following switches: English singular subject noun, English plural subject noun, Greek singular subject noun, and Greek plural subject noun. In these conditions the verb should be produced in the other language of the language of the subject noun. All English convergent and divergent nouns paralleled the Greek. The order of presentation was

individually randomized across and within lists and there was one convergent noun that preceded or followed any divergent noun (see Appendix A).

4.6.3 Post-Tests

4.6.3.1 Oral Translation

This was the same as in Experiment 1. (See Table 14).

	Divergent Nouns		**Convergent Nouns**	
Translation Direction	**Greek-English (L1-L2)**		**Greek-English (L1-L2)**	
	Pl (Greek) *Τα μαλλιά* ↓ **Sg (English)** *The hair is short*	**Sg (Greek)** *Το παντελόνι* ↓ **Pl (English)** *The trousers are black*	**Sg (Greek)** *Το δέντρο* ↓ **Sg (English)** *The tree is green*	**Pl (Greek)** *Τα βιβλία* ↓ **Pl (English)** *The books are old*
Scores (%)				
Correct	94	90	100	100
Errors	4	3	0	0
Omissions	2	4	0	0
Misc.	0	3	0	0

Table 14. Example sentences from oral translation test and results (%) for divergent & convergent nouns. (Singular = Sg; Plural = Pl).

We conducted two-paired sample t-tests on correct translations comparing convergent and divergent nouns for translations whose number in the target language was singular, and convergent and divergent nouns for translations whose number in the target language was plural. The results showed that significantly more correct translations in singular number were yielded for convergent than for divergent nouns; M = 100% vs. M = 94%, respectively [$t_1(19) = 4.68$; $t_2(11) = 3.02$]. That is, Greek-English bilinguals made no errors when they translated an L1 subject noun into an L2 subject noun whose number (singular) was the same in both languages (e.g., *Το δέντρο είναι πράσινο*; 'The tree is green'), but they yielded 4% errors when the subject noun was plural in L1 but singular in L2 (e.g., *Τα μαλλιά είναι*

κοντά; 'The hair is short'). The difference between convergent and divergent nouns for correct translations in plural number was also significant; M = 100% vs. M = 90%, respectively [$t_1(19) = 7.71$; $t_2(11) = 5.14$]. That is, no errors where made in translating a subject noun whose number (plural) was the same in L1 and in L2 (e.g., *Τα βιβλία είναι παλιά*; 'The books are old'), but there were 3% errors when translating a subject noun that was singular in L1 but plural in L2 (e.g., *Το παντελόνι είναι μαύρο*; 'The trousers are black'). Thus, as in Experiment 1, the results of the translation test confirmed bilinguals' knowledge of L2 translations as it was showed by the high scores on translation accuracy. However, there was also evidence of translation difficulty for nouns whose number diverged between the two languages, especially in L1 singular - L2 plural condition (*παντελόνι* → trousers). We attribute that to the ambiguous identity of this type of nouns for Greek-English bilinguals, and to the nature of the task which might not allow participants enough time to retrieve the correct translation.

4.6.3.2 Grammaticality Judgement

In addition, a grammaticality judgement task was delivered to ensure participants' agreement knowledge in the L2. This was similar to the one used in Experiments 1 and 2, except that we also introduced sentences in bilinguals' L1 (see Appendix B). We constructed two counterbalanced lists of 192 sentences each; 48 sentences contained divergent nouns and another 48 contained convergent nouns (24 in plural; 12 in Greek and 12 in English, and 24 in singular; 12 in Greek and 12 in English). Each noun appeared in a subject noun position. Each sentence was presented in two formats, one grammatically correct (e.g., *The hair is short*) and one with erroneous subject-verb agreement (e.g., **The hair are short*). Participants were instructed to read each pair and circle which of the two sentences they considered grammatically correct. Responses were calculated for correct S-V agreement after convergent and after divergent subject nouns.

	Divergent Nouns		Convergent Nouns	
Bilinguals				
	Singular	Plural	Singular	Plural
	A. *The hair is short*	A. *The trousers is black*	A. *The tree is green*	A. *The books is old*
	B. *The hair are short*	B. *The trousers are black*	B. *The tree are green*	B. *The books are old*
Scores(%)				
Correct	95	99	100	100
Errors	5	1	0	0

	Divergent Nouns		Convergent Nouns	
Monolinguals				
	Singular	Plural	Singular	Plural
	A. *The hair is short*	A. *The trousers is black*	A. *The tree is green*	A. *The books is old*
	B. *The hair are short*	B. *The trousers are black*	B. *The tree are green*	B. *The books are old*
Scores(%)				
Correct	99	100	100	100
Errors	1	0	0	0

Table 15. Example sentences from the grammaticality judgement task and results (%) for divergent and convergent nouns by Greek-English bilinguals and English monolinguals (control group).

The percentage of correct responses in L1 (Greek) for both noun-categories was 100%, *ts* < 1, thus, as in Expt. 1, we conducted two-paired sample t-tests for singular and plural correctly inflected verbs in L2 (English). For singular correctly inflected verbs after convergent and after divergent subject nouns the difference was significant whereby more correct responses were yielded in the former than in the latter case; $M = 100\%$ vs. $M = 95\%$, respectively [$t_1(19) = 4.33$; $t_2(23) = 10.41$]. That is, no errors were yielded for L2 singular nouns whose number was the same in L1, but there were 5% errors for L2 singular nouns whose number was plural in L1 (e.g., **The hair are short*). The difference between convergent nouns and divergent nouns for plural correctly inflected verbs was not significant; $M = 100\%$ vs. $M = 99\%$, respectively [$t_1(19) = 1.83$; $t_2(23) = 1.81$). That is, Greek-English bilinguals identified an L2 plural convergent subject noun sentence (e.g., *The books are old*) as correct as often as an L2 plural divergent subject noun sentence (e.g., *The trousers are black*). The results of the grammaticality judgement task

replicated those of Experiment 1. Namely, Greek-English bilinguals showed their advanced fluency and knowledge of agreement in the L2, but yielded more correct responses for convergent-noun sentences than for divergent-noun sentences. On the other hand, monolinguals' performance was perfect on both convergent and divergent subject noun sentences. Thus, we assume that Greek bilinguals' difficulty in processing divergent nouns in the L2 consists in those nouns' feature indiocyncracies across the two languages (that is, an effect of bilingualism).

4.6.3.3 Norming Study

This was the same as in Experiment 3. (All mean ratings on notional number by Greek-English bilinguals and by English monolinguals (control group) for the types of nouns used in Experiment 4 are presented in Table 16).

			Mean notional number (1 = one thing, 7 = more than one thing)				
Subject noun Condition		**Item in English**	**Bilingual Group**	**Monolingual Group**	**Item in Greek**		**Bilingual Group**
Convergent							
	Sg	*The tree*	1.00	1.09	Sg	*Το δέντρο*	1.00
	Pl	*The books*	5.79	4.98	Pl	*Τα βιβλία*	5.79
Divergent							
	Sg	*The hair*	2.67	2.30	Pl	*Τα μαλλιά*	3.46
	Pl	*The trousers*	3.21	1.73	Sg	*Το παντελόνι*	1.08

Table 16. Mean notional number for all items by Greek-English bilinguals & English monolinguals (control group). (Singular = Sg; Plural = Pl).

We performed the same analysis as in Expt. 3. The results yielded significant main effects of language (F_1 (1,19) = 426.25; F_2 (1,92) = 9.53), noun-number (F_1 (1,19) = 95275.49; F_2 (1,92) = 155.24), and noun-type (F_1 (1,19) = 2039.47; F_2 (1,92) = 21.20). The two-way interactions between

language and noun-number (F_1 (1,19) = 942.55; F_2 (1,92) = 46.13), language and noun-type (F_1 (1,19) = 688.06; F_2 (1,92) = 9.53), and noun-number and noun-type (F_1 (1,19) = 11890.52; F_2 (1,92) = 359.49) were also significant. Finally, the three-way interaction between language, noun-number and noun-type was significant (F_1 (1,19) = 1120.11; F_2 (1,92) = 46.13), meaning that the language x noun-number interaction was significantly different in convergent and divergent nouns. Thus, the mean ratings for singular and for plural convergent nouns in English and in Greek were the same across languages but, as expected, differed across number. The mean ratings for singular and for plural divergent nouns showed that English singular divergent nouns (*hair*) were considered more plural than English or Greek singular convergent nouns (*tree*), yet not as plural as English or Greek plural convergent nouns (*books*). English plural divergent nouns (*trousers*, having either a singular or plural morphology in Greek depending on the context) were thought more plural than English or Greek singular convergent nouns (*tree*), but less plural than English or Greek plural convergent nouns (*books*). Greek singular divergent nouns (*παντελόνι*; 'trousers' in Greek) were considered as singular as English or Greek singular convergent nouns (*tree*), whereas Greek plural divergent nouns (*μαλλιά*; 'hair') were considered more plural than English or Greek singular convergent nouns (*tree*), but less plural than English or Greek plural convergent nouns (*books*).

4.6.4 Procedure

Participants were seated at a computer in a booth and were instructed entirely in English. Participants told to read aloud the beginning of a sentence that would be displayed at the centre of the computer screen. As soon as they did so, a square coloured either blue or red would be voice-triggered and take the place of the previous item for 2000 ms. Within that time participants had to complete the sentence in the appropriate language depending on the colour of the square; a blue square would be equivalent to 'complete in Greek', whereas a red square would be equivalent to 'complete in English'. The session began with 8 practice trials of convergent nouns, four of which were in singular and another four were in plural. From each set of four subject nouns 2 trials were in L2 (one in single-language and one in CS) and 2 trials were in L1 (one in single-language and one in CS). None of the items used was included in the experiment. This allowed the experimenter to ensure that participants had understood the task.

Participants were asked to perform as fast as possible and press the spacebar for the experiment to start. Each session lasted about fifteen minutes. All answers were recorded and transcribed for further analysis.

4.6.5 Scoring

Participants' responses were assigned to the following scoring categories: responses in *singular* were scored when participants produced a verb in singular and responses in *plural* were scored when the produced verb was in plural. *Omissions* were scored when no answer was given and *miscellaneous* (misc.) when there were responses that either overrode the instructions of the experimental task or were unspecified for number. Such an example would be the production of a verb in the same language as the subject noun in a CS condition, or the production of a verb in a different language than the subject noun in a single-language condition. An example of unspecified response would be Τα εγκαίνια *started* ('The inauguration start-Past?'), where it is impossible to determine the number of the verb because simple past tense in English is the same for singular and for plural number. The utterance that was first produced even in cases where participants corrected themselves was scored as a valid one.

4.6.6 Design and Data Analysis

A 2 source-language (Greek vs. English) x 2 source-language number (singular vs. plural) x 2 language-task (single-language vs. CS) x 2 source-language noun type (convergent vs. divergent) design was created. All four factors were within-participants. The factors source-language and language-task were within-items, and the factors source-language number and noun-type were between-items. Responses in singular, in plural, omissions and miscellaneous responses constituted the dependent variables. Two analyses of variance with the proportions of the dependent variables, one for participants (F1) and one for items (F2) were carried out.

4.6.7 Results

Percentages of responses in the four scoring categories are shown in Table 17.

Single-Language Condition

Language of Noun Phrase

		Greek (L1)					**English (L2)**				
Subj.-Noun Condition		**Scores in L1** Singular	Plural	Omiss.	Misc.		**Scores in L2** Singular	Plural	Omiss.	Misc.	
Conv.	Sg (δέντρο)	100	0	0	0	**Conv.**	Sg (tree)	100	0	0	0
	Pl (βιβλία)	0	100	0	0		Pl (books)	0	99	1	0
Div.	Sg (παντελόνι)	99	0	1	0	**Div.**	Sg (hair)	65	15	18	2
	Pl (μαλλιά)	0	98	2	0		Pl (trousers)	5	89	6	0

CS Condition

Language of Noun-Phrase

		Greek (L1)					**English (L2)**				
Subj.-Noun Condition		**Scores in L2** Singular	Plural	Omiss.	Misc.		**Scores in L1** Singular	Plural	Omiss.	Misc.	
Conv.	Sg (δέντρο)	96	0	3	1	**Conv.**	Sg (tree)	99	0	1	0
	Pl (βιβλία)	0	95	4	1		Pl (books)	0	99	1	0
Div.	Sg (παντελόνι)	93	2	5	0	**Div.**	Sg (hair)	21	55	21	3
	Pl (μαλλιά)	0	95	5	0		Pl (trousers)	6	85	9	0

Table 17. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Divergent = Div.; Singular = Sg; Plural = Pl).

Application of the scoring criteria for singular inflected verbs, plural inflected verbs, omissions and miscellaneous responses are reported in Table 18.

Source of variance		**F1** (1,19)	**F2** (1,92)
		F1 value	**F2 value**
Singular	Source-language	191.038***	68.132***
	Source-language number	21356.723***	516.892***
	Language-task	89.122***	28.315***
	Noun-type	465.344***	70.460***
	SL x SLN	256.021***	530.497***
	SL x LT	162.543***	21.634***
	SLN x LT	122.625***	22.892***
	SL x NT	239.769***	70.533***
	LT x NT	115.021***	19.597***
	SLN x NT	967.719***	1738.748***
	SL x SLN x LT	127.650***	31.475***
	SL x LT x NT	126.891***	25.350***
	SL x SLN x NT	294.799***	523.876***
	SLN x LT x NT	123.275***	15.134***
	SL x SLN x LT x NT	131.332***	35.927***
Plural	Source-language	146.745***	17.591***
	Source-language number	21462.324***	482.737***
	Language-task	26.891***	5.388*
	Noun-type	35.325***	9.425***
	SL x SLN	227.327***	555.404***
	SL x LT	74.161***	14.144***
	SLN x LT	93.889***	15.160***
	SL x NT	82.777***	17.037***
	LT x NT	44.333***	9.890***
	SLN x NT	258.960***	1218.937***
	SL x SLN x LT	47.038***	22.843***
	SL x LT x NT	55.398***	15.968***
	SL x SLN x NT	279.021***	552.270***
	SLN x LT x NT	86.031***	9.424***
	SL x SLN x LT x NT	50.567***	20.652***
Omissions	Source-language	25.710***	27.989***
	Source-language number	17.095***	3.646 (p = .06)
	Language-task	11.603***	9.369***
	Noun-type	36.393***	25.545***
	SL x SLN	14.387***	10.981***
	SL x LT	4.037 (p = .06)	.028
	SLN x LT	.015	.004
	SL x NT	39.118***	31.801***

	LT x NT	1.310	.609
	SLN x NT	24.085***	4.554*
	SL x SLN x LT	11.575***	.254
	SL x LT x NT	2.232	.003
	SL x SLN x NT	.202	13.415***
	SLN x LT x NT	.014	.032
	SL x SLN x LT x NT	.005	.254
Miscellaneous	Source-language	5.000**	6.624**
	Source-language number	5.000**	4.600*
	Language-task	3.353	1.605
	Noun-type	5.000**	4.600*
	SL x SLN	3.519	6.624**
	SL x LT	.322	.713
	SLN x LT	.322	.178
	SL x NT	8.387***	6.624**
	LT x NT	.322	.178
	SLN x NT	3.519	4.600*
	SL x SLN x LT	.322	.713
	SL x LT x NT	3.353	.713
	SL x SLN x NT	5.000**	2.944
	SLN x LT x NT	.322	.178
	SL x SLN x LT x NT	.322	.000

Table 18. Results of 4-way ANOVAs with the proportions of singular and plural inflected verbs, omissions and miscellaneous responses (factors: source-language (SL), source-language number (SLN), language-task (LT), and noun-type (NT)).

4.6.7.1 Results of Analysis on Convergent Nouns

Moreover, we conducted t-tests to make the following comparisons for convergent subject nouns: (a) across languages within each language task, and (b) across language tasks within each language. Across languages, for the single-language task, the percentage of correct responses in singular number was 100%, *ts* < 1, for both L1 (e.g., *Το δέντρο είναι πράσινο*) and L2 (e.g., *The tree is green*). The results of the comparison between L1 and L2 on correctly inflected verbs in plural number (e.g., *Τα βιβλία είναι παλιά*/*The books are old*) showed that the difference between the two languages was not significant either; M = 100% vs. M = 99%, respectively [$t_1(19) = 1.45$; $t_2(23) = 1.45$]. For the CS task, the results of correctly inflected verbs showed a significant difference between languages for both numbers in the analysis by participants; more correct responses were given in L2-L1 direction (e.g., The tree *είναι*

πράσινο/The books *είναι παλιά*) than in L1-L2 direction (e.g., Το δέντρο *is green*/Τα βιβλία *are old*): in singular number; $M = 99\%$ vs. $M = 96\%$ [$t_1(19) = 2.33$; $t_2(23) = 1.00$], and in plural number respectively; $M = 99\%$ vs. $M = 95\%$ [$t_1(19) = 2.65$; $t_2(23) = .30$].

Comparing across language tasks, the difference between single-language and CS for correct responses when the source-noun language was the L1 (Greek) was significant for both numbers. That is, more correct responses in singular were given in single-language (e.g., *Το δέντρο είναι πράσινο*) than in L1-L2 CS direction (Το δέντρο *is green*); $M = 100\%$ vs. $M = 96\%$ [$t_1(19) = 2.93$; $t_2(23) = 3.08$]. Also, in plural number more correct responses were given in single-language (*Τα βιβλία είναι παλιά*) than in L1-L2 CS direction (Τα βιβλία *are old*) in the analysis by participants; $M = 100\%$ vs. $M = 95\%$, respectively [$t_1(19) = 2.98$; $t_2(23) = 1.45$]. For correct responses when the source-noun language was the L2, the percentage in plural was 99% for both single-language (*The books are old*) *and* CS (The books *είναι παλιά*) conditions, $ts < 1$. The difference between single-language (*The tree is green*) and CS (e.g., The tree *είναι πράσινο*) for singular number was not significant either; $M = 100\%$ vs. $M = 99\%$, respectively [$t_1(19) = .57$; $t_2(23) = 1.14$]. To summarize the results of single-language and code-switching conditions with convergent nouns, we found that in single-language correct verb-implementation was the same for singular subject nouns across the two languages. In CS, S-V agreement seemed to be a lot easier when the L1 was the target language. As we predicted, agreement computation was unimpeded both in single-language and in code-switching because the number of the subject noun phrases was matched in the two languages.

4.6.7.2 Results of Analysis on Divergent Nouns

In addition, we conducted t-tests for divergent subject nouns to compare correctly inflected verbs in the single-language task across languages and within languages. Across languages, the difference of correctly produced verbs following L1 and L2 singular nouns was significant whereby more correct responses were given in the L1 (e.g., *Το παντελόνι είναι μαύρο*) than in the L2 (e.g., *The hair is short*); $M = 99\%$ vs. $M = 65\%$, respectively [$t_1(19) = 8.11$; $t_2(23) = 5.24$]. The difference between the two languages was also significant for verbs that were produced after plural nouns whereby more correct responses were given in the L1 (e.g., *Τα μαλλιά είναι κοντά*) than in the L2 (e.g., *The trousers are black*);

M = 98% vs. M = 89%, respectively [$t_1(19)$ = 2.34; $t_2(23)$ = 2.40]. Within languages, the results showed that more correctly inflected verbs were produced following an L2 plural noun (e.g., *The trousers are black*) than an L2 singular noun (e.g., *The hair is short*); M = 89% vs. M = 65% [$t_1(19)$ = 6.98; $t_2(23)$ = 3.04]. The difference between correctly inflected verbs following an L1 singular noun (e.g., *Το παντελόνι είναι μαύρο*) or an L1 plural noun (e.g., *Τα μαλλιά είναι κοντά*) was not significant; M = 98% and M = 99% [$t_1(19)$ = .57; $t_2(23)$ = .44]. In summary, the results of single-language completion with divergent subject nouns showed that agreement proceeded without difficulty for sentence completion in bilinguals' L1 (Greek). However, sentence completion in L2 (English) produced errors, especially with singular divergent subject nouns (*hair*) where influence on verb-inflection could have originated from the L1 plural counterpart (*μαλλιά*). We argue that the amount of errors committed within the L2 might imply that Greek-English bilinguals sometimes produced the number that was appropriate for the Greek translation equivalent (see also results of Expt. 1).

We also conducted t-tests to examine speakers' responses with divergent nouns within each switch direction. In L1-L2 direction, the results of both singular and plural subject noun completions showed that the produced verb tended to acquire the number specification of the L1 subject noun. Thus, after L1 singular nouns more singular than plural inflected verbs were produced in L2 (e.g., Το παντελόνι *is black*; 'The trousers is black'); M = 95% vs. M = 0% [$t_1(19)$ = 48.81; $t_2(23)$ = 39.31], and after L1 plural nouns more plural than singular inflected verbs were produced in L2 (e.g., Τα μαλλιά *are short*; 'The hair are short'); M = 93% vs. M = 2% [$t_1(19)$ = 35.74; $t_2(23)$ = 24.81]. In L2-L1 direction, after L2 singular nouns more plural than singular inflected verbs were produced in L1 (e.g., The hair *είναι κοντά*; 'The hair are short'); M = 55% vs. M = 21% [$t_1(19)$ = 7.91; $t_2(23)$ = 2.47], and after L2 plural nouns more plural than singular inflected verbs were produced in L1 (e.g., The trousers *είναι μαύρα*; 'The trousers are black'); M = 85% vs. M = 6% [$t_1(19)$ = 29.42; $t_2(23)$ = 9.16]. (We discuss these results in more detail in the *Discussion* section of this chapter). The results of code-switching with divergent nouns can be summarized in the following two observations: first, in L1-L2 direction, the produced verb more often acquired the number features of the L1 subject noun than not; second, in L2-L1 direction, number influence of the L1 target language prevailed on verb-computation in more than half of the responses.

4.6.7.3 Single-Language Results: Monolinagual vs. Bilingual Mode

More importantly, we conducted independent-sample t-tests to compare the findings from agreement implementation in single-language production in L2 (English) between monolingual mode (Expt. 1) and bilingual mode (Expt. 4). This comparison was based on the hypothesis that number divergence across the two languages would increase influence of the L1 on the L2 in a task where both languages would have equal share of activation and participation. Thus, by including CS conditions in the same session as single-language conditions (bilingual mode), we could test directly the effects of mode of speech on single-language completion.

Regarding S-V agreement for convergent nouns, there was no significant difference in performance between the two modes, since in both experiments 100% correct responses were produced following singular nouns (*tree*) and 99% correct responses were yielded following plural nouns (*books*), $ts < 1$. In contrast, with divergent nouns, bilinguals' performance in Expt. 4 (bilingual mode) differed significantly from bilinguals' performance in Expt. 1 (monolingual mode). Namely, fewer errors were committed in single-language in the monolingual mode where no code-switching had taken place than in single-language in the bilingual mode where bilinguals had also performed on CS conditions in the same experimental session. Following singular divergent nouns (*hair*), the difference in error occurrence between the two modes was significant; $M = 4\%$ vs. $M = 15\%$ [$t_1(19) = 4.41$; $t_2(23) = 4.33$]. The same was true in the analysis by participants following plural divergent nouns (*trousers*); $M = 1\%$ vs. $M = 5\%$ [$t_1(19) = 5.78$; $t_2(23) = 1.40$]. The difference in correct responses between the two modes was significant both after singular divergent nouns (*hair*); $M = 95\%$ vs. $M = 65\%$ [$t_1(19) = 8.92$; $t_2(23) = 5.68$], and after plural divergent nouns (*trousers*); $M = 96\%$ vs. $M = 89\%$ [$t_1(19) = 7.68$; $t_2(23) = 2.20$]. We may account this difference to parallel language activation and strong language competition during a mixed-language task (Expt. 4) which even spilt its influence over instances of single-language production. (Figure 6 shows the proportions of correctly inflected verbs in single-language after L2 singular and plural subject nouns in a monolingual mode setting (not involving CS, Expt. 1), and in a bilingual mode setting (also involving CS, Expt. 4)).

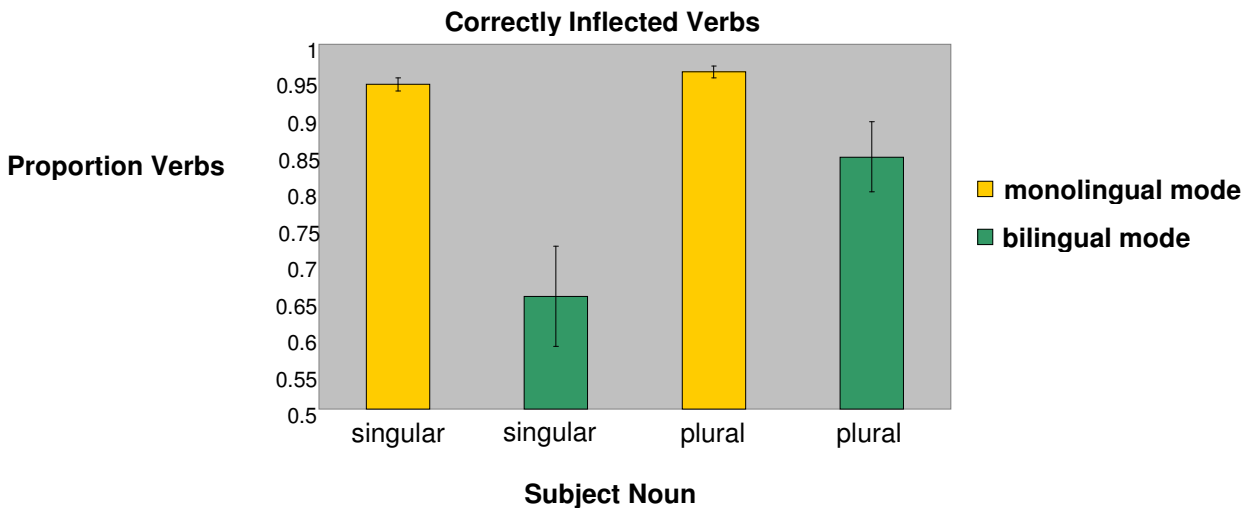

Figure 6. Comparison of correct S-V agreement in L2 (English) with divergent nouns by Greek-English bilinguals during the monolingual mode (Expt. 1) vs. the bilingual mode (Expt. 4). (Divergent = Div.).

4.7 Discussion

In accordance with our prediction for the effects of divergent subject nouns during the bilingual mode, we found that number influence of the L1 was almost three times larger than it was in the monolingual mode. This was showed from the comparison of agreement performance on single-language (i.e., L2 subject noun - verb completion in L2) during strictly monolingual production (Expt. 1) and on single-language during the bilingual mode (where CS also took place) to performance on L2-L1 code-switching (i.e., L2 subject noun - verb completion in L1) (Expt. 4). Regarding singular number influence from the L1, there was 1% influence during single-language production in the monolingual mode (Expt. 1), 5% influence during single-language production in the bilingual mode (Expt. 4), and 6% influence in L2-L1 code-switched production (Expt. 4). As far as plural number influence from the L1 is concerned, there was 4% influence during single-language production in the monolingual mode (Expt. 1), 15% influence during single-language production in the bilingual mode (Expt. 4), and 55% influence during L2-L1 code-switched production (Expt. 4). Put in a different way, the increase of the amount of influence of the contrasting number of the L1 could be described as follows: *single-language production in the monolingual mode* < *single-language production in the bilingual mode* < *code-switched production*. (See Figures 7 and 8 for a comparison of L1 influence after L2 singular and plural subject nouns in single-

language production during the monolingual mode, single-language production during the bilingual mode, and in L2-L1 CS).

We also found that increase of the L1 number influence after L2 plural divergent nouns (*trousers*) for each mode of speech was low overall (the difference between single-language production in the bilingual mode and code-switching was not significant). The reason for this may be that English plural divergent nouns can bear either a singular or a plural marking in Greek depending on the numerosity of the noun (e.g., 'one pair of trousers' translates into *παντελόνι* bearing a singular marking, whereas 'more than one pair of trousers' translates into *παντελόνια* bearing a plural marking). We assume that time-pressure of the on-line task led the speakers to provide a plural agreement marking that would match the grammatically plural English subject noun, thus making the effect of the number clash between the two languages smaller.

Thus, our prediction for divergent nouns that single-language performance in a monolingual environment should somewhat differ from single-language performance in a bilingual environment was confirmed. We explain that difference by arguing that during a language task which involved CS, there was strong competition between the subject noun and its translation equivalent at all times. Thus, in the bilingual mode, where speakers alternated from language to language, it was very likely that even in single-language completion in the L2 (e.g., *The hair…*), the plural L1 translation *μαλλιά* received strong activation often passing its plural number specification to the verb, overriding correct S-V in the L2 (**The hair are short*). This pattern seemed to increase even more in CS (The hair *είναι κοντά*; 'The hair are short'). As we discussed in the introduction, this account parallels accounts of errors reported in monolingual literature on number agreement where the grammatical plural number feature of a local noun has been found to be copied to the verb in singular head noun sentences (Bock and colleagues; e.g., Bock & Cutting, 1992; Vigliocco and colleagues; e.g., Vigliocco et al., 1995).

Another finding in Experiment 4 that may relate to how tightly integrated morphological and notional features are into language processing by Greek-English bilinguals is that during the on-line sentence-completion task speakers tended to provide plural marking on the verb after L2 plural divergent subject nouns (e.g., *trousers*). However, in the translation post-test, when they were given a sentence with its L1

singular counterpart to translate in the L2, they were able to identify correctly the morphological asymmetry that existed for the same notion across the two languages. Thus, we may assume that highly demanding on-line tasks may lead speakers to misassign grammatical features (e.g., Hupet, Fayol, & Schelstraete, 1998).

Moreover, it is very likely for speakers of a rich inflectional language system, where morphology is tightly interwoven with meaning, as in Greek, to be influenced by any kind of feature marking, either overt or implied. The norms we collected also provide support for such an interpretation, because nouns whose morphological and notional number coincided (convergent nouns) were given clear ratings of plurality or singularity, whereas nouns whose morphological number in the L2 differed from their morphological number in the L1 (e.g., *hair*) were given ratings showing influence from the L1.

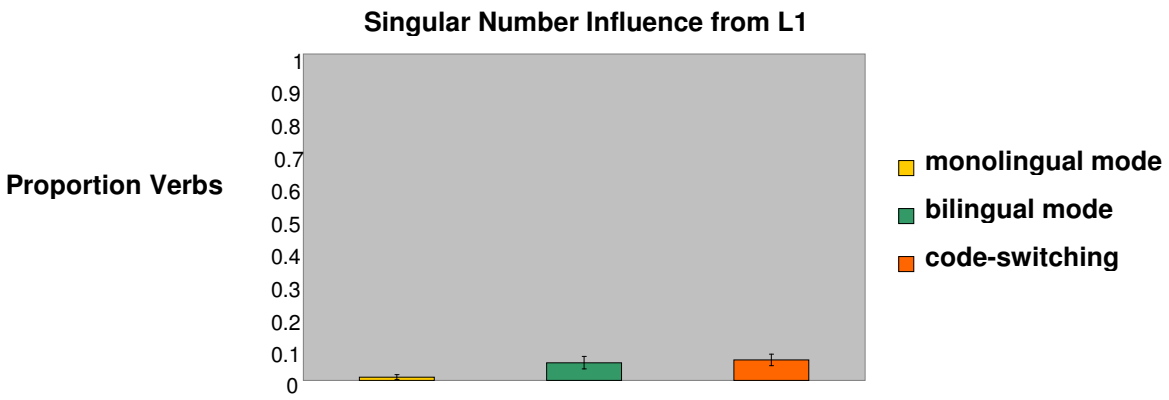

Figure 7. Singular number influence of the L1 on verb-agreement after L2 plural divergent nouns (*trousers*) during single-language production in the monolingual mode (Expt. 1), single-language production in the bilingual mode (Expt. 4), and L2-L1 code-switched production (Expt. 4) by Greek-English bilinguals.

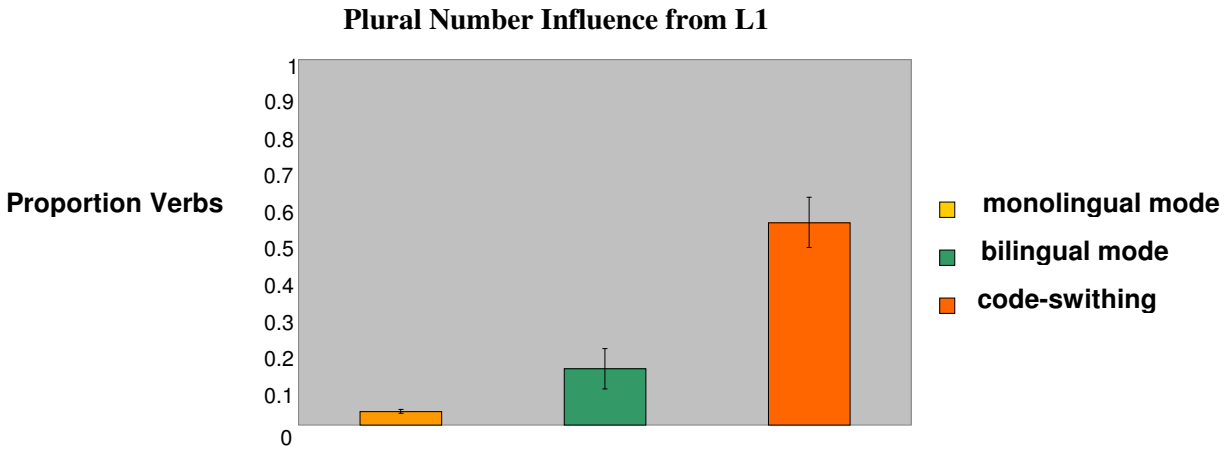

Figure 8. Plural number influence of the L1 on verb-agreement after L2 singular divergent nouns (*hair*) during single-language production in the monolingual mode (Expt. 1), single-language production in the bilingual mode (Expt. 4), and L2-L1 code-switched production (Expt. 4) by Greek-English bilinguals.

EXPERIMENT 5: Sentence-Completion in Mixed-Language Production by English-Greek Bilinguals

4.8 Rationale and Predictions

Experiment 4 (bilingual mode setting) with Greek-English bilinguals of L2 English, yielded two important findings: (a) code-switching exaggerated the number clash of divergent nouns across the two languages, especially in L2-L1 direction with singular nouns whose translation equivalent was plural in the L1 (e.g., The hair *είναι κοντά*; 'The hair are short'); (b) plural number influence of the L1 was present not only in code-switching conditions (e.g., The hair *είναι κοντά*) but also in single-language conditions (e.g., **The hair are short*). In Experiment 5, we test English native speakers whose second language is Greek to examine whether the phenomena observed for Greek-English bilinguals in the bilingual mode (single-language and code-switched production) would be similar to English-Greek bilinguals who performed in the same bilingual mode setting.

4.9 Method

4.9.1 Participants

Twenty English-Greek fluent bilinguals who were native speakers of English and spoke Greek as a second language were paid to participate. They all had received formal instruction in Greek (which included systematic practice involving grammar, and plenty of opportunities for conversation as well as directed self-study) through private tuition for a mean of 4 years (SD = .82) before moving to Greece. At the time of the testing, they had been living in Athens for 15 years on average and had been using their L2 on an everyday basis. Their average age was 48 years (SD = 2.3). None of them had participated in Experiment 2, but as in Experiment 2, participants were recruited through advertisements which clearly stated as a prerequisite proficiency in the bilinguals' second language. As we shall see below, English-Greek bilinguals' highly correct performance on both L2 proficiency tests (particularly in the grammaticality judgement task, M = 95-98% of correct responses for divergent nouns and M = 100% of correct responses for convergent nouns) demonstrated that participants possessed the relevant grammatical knowledge of agreement.

A control group of Greek monolinguals (average age 52 years; SD = 2.1) living in Athens was also tested on the grammaticality judgement task and participated in the norming study (see next section). The findings from the comparison between the performance of Greek monolinguals on S-V agreement and the performance of English-Greek bilinguals on the same grammatical features provided further support for the claim that any differences observed in agreement computation between convergent and divergent nouns by English-Greek bilinguals were due to bilingualism and not to the materials. Indeed, Greek monolinguals did not differentiate between convergent and divergent noun agreement, and yielded 100% correct responses in both cases. (The scores of the performance of Greek monolinguals on the grammaticality judgement task are reported in Table 20 along with the scores of English-Greek bilinguals in L2).

4.9.2 Materials

Materials were identical to those described in Experiment 4.

4.9.3 Post-Tests

4.9.3.1 Oral Translation

This was the same as in Experiment 2. (See Table 19).

	Divergent Nouns		**Convergent Nouns**	
Translation Direction	**English-Greek (L1-L2)**		**English-Greek (L1-L2)**	
	Sg (English)	**Pl (English)**	**Sg (English)**	**Pl (English)**
	The hair	*The trousers*	*The tree*	*The books*
	↓	↓	↓	↓
	Pl (Greek)	**Sg (Greek)**	**Sg (Greek)**	**Pl (Greek)**
	Τα μαλλιά είναι κοντά	*Το παντελόνι είναι μαύρο*	*Το δέντρο είναι πράσινο*	*Τα βιβλία είναι παλιά*
Scores (%)				
Correct	93	96	100	97
Errors	2	1	0	1
Omissions	5	1	0	2
Misc.	0	2	0	0

Table 19. Example sentences from oral translation test and results (%) for divergent & convergent nouns. (Singular = Sg; Plural = Pl).

As in Expt. 2, we conducted two-paired sample t-tests on correct translations comparing convergent and divergent nouns for translations whose number in the target language was singular, and convergent and divergent nouns for translations whose number in the target language was plural. The results showed that significantly more correct translations in singular number were yielded for convergent nouns than for divergent nouns in the analysis by participants; M = 100% vs. M = 96%, respectively [$t_1(19) = 3.68$; $t_2(11) = 1.89$]. That is, English-Greek bilinguals made no errors when they translated an L1 subject noun into the L2 whose subject noun number (singular) was the same in both languages, but yielded 1% errors, 1% omissions and 2% miscellaneous responses when the L1 subject noun was plural but its L2 translation was singular (e.g., *The trousers are black* → *Το παντελόνι είναι μαύρο*). The difference between convergent and divergent nouns for correct translations in plural number was also significant in the analysis by participants. That is, fewer errors (1% vs. 2%) and fewer omissions (2% vs. 5%) were yielded when the speakers translated into the L2 plural subject nouns whose number was the same in

both languages than when they translated L1 singular subject nouns into their L2 plural equivalents (e.g., *The hair is short → Τα μαλλιά είναι κοντά*); $M = 97\%$ vs. $M = 93\%$ [$t_1(19) = 2.13$; $t_2(11) = .79$].

4.9.3.2. Grammaticality Judgement

A grammaticality judgement test was conducted as in Experiment 2 to test participants' knowledge of agreement in the L2. Responses were calculated for correct S-V agreement after convergent and after divergent subject nouns for each number in each language.

Divergent Nouns

Plural	**Singular**
A. *Τα μαλλιά είναι κοντά* 'The hair is short'	A. *Το παντελόνι είναι μαύρα* 'The trousers is black'
B. *Τα μαλλιά είναι κοντό* 'The hair are short'	B. *Το παντελόνι είναι μαύρο* 'The trousers are black'

Scores (%)	**Bilinguals**	**Monolinguals**	**Bilinguals**	**Monolinguals**
Correct	95	100	98	100
Errors	5	0	2	0

Convergent Nouns

Singular	**Plural**
A. *Το δέντρο είναι πράσινο* 'The tree is green'	A. *Τα βιβλία είναι παλιό* 'The books is old'
B. *Το δέντρο είναι πράσινα* 'The tree are green'	B. *Τα βιβλία είναι παλιά* 'The books are old'

Scores (%)	**Bilinguals**	**Monolinguals**	**Bilinguals**	**Monolinguals**
Correct	100	100	100	100
Errors	0	0	0	0

Table 20. Example sentences from the grammaticality judgement task and results (%) for divergent & convergent nouns by English-Greek bilinguals and Greek monolinguals (control group).

In L1 (English), for correctly inflected verbs after singular convergent nouns (*The tree is green*) and after singular divergent nouns (*The hair is short*) the difference was significant whereby more correct responses were produced after convergent than after divergent nouns; M = 100% vs. M = 96% [$t_1(19)$ = 2.94; $t_2(23)$ = 3.50]. For correctly inflected verbs following plural convergent nouns (*The books are old*) and plural divergent nouns (*The trousers are black*) the difference was not significant; M = 100% vs. M = 99%, respectively [$t_1(19)$ = 1.83; $t_2(23)$ = 1.81). In L2 (Greek), for correctly inflected verbs after singular convergent nouns (*Το δέντρο είναι πράσινο*; 'The tree is green') and after singular divergent nouns (*Το παντελόνι είναι μαύρο*; 'The trousers are black') the difference was significant whereby more correct responses were yielded after convergent than after divergent nouns; M = 100% vs. M = 98% [$t_1(19)$ = 2.35; $t_2(23)$ = 2.30]. Participants also produced more correctly inflected verbs following plural convergent nouns (*Τα βιβλία είναι παλιά*; 'The books are old') than following plural divergent nouns (*Τα μαλλιά είναι κοντά*; 'The hair is short'); M = 100% vs. M = 95% [$t_1(19)$ = 4.94; $t_2(23)$ = 4.03]. Thus, the results of the grammaticality judgement task showed English-Greek bilinguals' satisfactory knowledge of agreement in the L2. Interestingly, as in Experiment 2, most errors were yielded in plural divergent noun sentences in the L2 (*μαλλιά*) whose L1 translation was singular (*hair*). We may account this finding to a conflict between the semantic and syntactic features of this type of nouns between the two languages (see next section for more information). Monolinguals' performance was perfect on both convergent and divergent subject noun sentences which shows that the difference in correct responses between convergent and divergent noun sentences by English-Greek bilinguals was an effect of bilingualism and not of the materials used.

4.9.3.3 Norming Study

This was the same as in Experiment 4. (See Table 21 for all mean ratings on notional number by English-Greek bilinguals and by Greek monolinguals for the categories of nouns used in Expt. 5).

Mean Notional Number (1 = one thing, 7 = more than one thing)						
Subject Noun Condition		**Item in English**	**Bilingual Group**	**Item in Greek**	**Bilingual Group**	**Monolingual Group**
Convergent						
	Sg	*The tree*	1.00	Sg *Το δέντρο*	1.00	1.00
	Pl	*The books*	4.46	Pl *Τα βιβλία*	4.54	4.67
Divergent						
	Sg	*The hair*	1.83	Pl *Τα μαλλιά*	2.38	4.25
	Pl	*The trousers*	1.25	Sg *Το παντελόνι*	1.00	1.00

Table 21. Mean notional number for all Items by English-Greek bilinguals & Greek monolinguals (control group). (Singular = Sg; Plural = Pl).

We performed the same analysis as in Experiments 3 and 4. The results yielded a significant main effect of language in the analysis by participants (F_1 (1,19) = 57.60; F_2 (1,92) = 2.03), and significant main effects of noun-number (F_1 (1,19) = 35686.43; F_2 (1,92) = 151.75), and noun-type (F_1 (1,19) = 6332.65; F_2 (1,92) = 123.15). The two-way interaction between language and noun-number (F_1 (1,19) = 1102.57; F_2 (1,92) = 7.23) was significant. The interaction language and noun-type was significant in the analysis by participants (F_1 (1,19) = 27.01; F_2 (1,92) = .63). Finally, the noun-number and noun-type interaction was also significant (F_1 (1,19) = 14919.24; F_2 (1,92) = 479.12). More mportantly, the three-way interaction between language, noun-number and noun-type was significant (F_1 (1,19) = 2282.12; F_2 (1,92) = 11.04), meaning that the language x noun-number interaction was significantly different in convergent and divergent nouns. Thus, English singular divergent nouns (*hair*) were considered more plural than English singular convergent nouns (*tree*) or English plural divergent nouns (*trousers*) but less plural than English plural convergent nouns (*books*). The same was true for when these items were seen in Greek with ratings for singular divergent nouns weighing more towards singular number and with ratings for plural divergent nouns weighing more towards plural number.

4.9.4 Procedure, Scoring, Design and Data Analysis

These were identical to those of Experiment 4.

4.9.5 Results

Percentages of responses in the four scoring categories are shown in Table 22.

Single-Language Condition

		Language of Noun-Phrase: Greek (L2)					**English (L1)**			
Subj.-Noun Condition		**Scores in L2** Singular	Plural	Omiss.	Misc.		**Scores in L1** Singular	Plural	Omiss.	Misc.
Conv.	Sg (δέντρο)	99	0	1	0	**Conv.** Sg (tree)	100	0	0	0
	Pl (βιβλία)	0	98	2	0	Pl (books)	0	100	0	0
Div.	Sg (παντελόνι)	90	6	3	1	**Div.** Sg (hair)	92	8	0	0
	Pl (μαλλιά)	17	78	2	3	Pl (trousers)	7	92	1	0

CS Condition

		Language of Noun-Phrase: Greek (L2)					**English (L1)**			
Subj.-Noun Condition		**Scores in L1** Singular	Plural	Omiss.	Misc.		**Scores in L2** Singular	Plural	Omiss.	Misc.
Conv.	Sg (δέντρο)	99	0	1	0	**Conv.** Sg (tree)	99	0	1	0
	Pl (βιβλία)	0	98	2	0	Pl (books)	0	98	2	0
Div.	Sg (παντελόνι)	64	14	14	8	**Div.** Sg (hair)	73	10	7	10
	Pl (μαλλιά)	58	25	8	9	Pl (trousers)	17	55	12	16

Table 22. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Divergent = Div.; Singular = Sg; Plural = Pl).

Application of the scoring criteria for singular inflected verbs, plural inflected verbs, omissions and miscellaneous responses are reported in Table 23.

Source of variance		**F1** (1,19)	**F2** (1,92)
		F1 value	**F2 value**
Singular	Source-language	26.979***	7.605***
	Source-language number	5015.783***	1241.597***
	Language-task	.385	.209
	Noun-type	8.050***	2.755
	SL x SLN	63.439***	269.728***
	SL x LT	9.423***	7.389***
	SLN x LT	117.519***	11.754***
	SL x NT	33.379***	9.389***
	LT x NT	.527	.145
	SLN x NT	449.036***	655.226***
	SL x SLN x LT	17.514***	120.339***
	SL x LT x NT	6.798*	7.926***
	SL x SLN x NT	65.681***	259.758***
	SLN x LT x NT	134.434***	11.237***
	SL x SLN x LT x NT	20.720***	122.478***
Plural	Source-language	41.991***	10.968***
	Source-language number	5484.584***	1527.533***
	Language-task	145.224***	89.980***
	Noun-type	134.411***	90.494***
	SL x SLN	35.965***	261.924***
	SL x LT	1.159	1.103
	SLN x LT	200.874***	8.335***
	SL x NT	25.733***	8.262***
	LT x NT	108.756***	100.026***
	SLN x NT	447.895***	945.608***
	SL x SLN x LT	6.657*	137.945***
	SL x LT x NT	2.946	1.787
	SL x SLN x NT	23.501***	247.957***
	SLN x LT x NT	152.961***	5.624*
	SL x SLN x LT x NT	9.573***	131.298***
Omissions	Source-language	15.915***	3.651 (p = .059)
	Source-language number	.130	3.068
	Language-task	74.290***	44.420***
	Noun-type	126.542***	52.083***
	SL x SLN	11.427***	.005
	SL x LT	1.567	.061
	SLN x LT	.170	3.843 (p = .053)
	SL x NT	2.111	.846

	LT x NT	66.397***	38.370***
	SLN x NT	.051	4.718*
	SL x SLN x LT	12.164***	.007
	SL x LT x NT	.655	.061
	SL x SLN x NT	15.915***	.125
	SLN x LT x NT	.371	1.383
	SL x SLN x LT x NT	5.381*	.061
Miscellaneous	Source-language	1.447	.705
	Source-language number	15.487***	1.428
	Language-task	81.986***	26.778***
	Noun-type	36.577***	41.976***
	SL x SLN	.719	1.683
	SL x LT	7.942**	8.275***
	SLN x LT	9.563***	.594
	SL x NT	1.487	2.568
	LT x NT	35.426***	39.006***
	SLN x NT	2.330	.004
	SL x SLN x LT	4.005	2.182
	SL x LT x NT	8.228***	4.407*
	SL x SLN x NT	1.773	4.246*
	SLN x LT x NT	.642	2.579
	SL x SLN x LT x NT	8.559***	.490

Table 23. Results of 4-way ANOVAs with the proportions of singular and plural inflected verbs, omissions and miscellaneous responses (factors: source-language (SL), source-language number (SLN), language-task (LT), and noun-type (NT)).

4.9.5.1 Results of Analysis on Convergent Nouns

As in Experiment 4, we conducted t-tests to make the following comparisons for convergent subject nouns: (a) across languages within each language task, and (b) across language tasks within each language. Across languages for the single-language task, the results of the comparison between the L1 and the L2 on correctly inflected verbs in singular number (*The tree is green*/*Το δέντρο είναι πράσινο*) showed that the difference between the two languages was not significant; M = 100% vs. M = 99% [$t_1(19) = 1.83$; $t_2(23) = 1.81$]. The difference between the two languages on correctly inflected verbs in plural number was significant in the analysis by participants whereby more correct responses were given after L1 (*The books are old*) than after L2 plural subject nouns (*Τα βιβλία είναι παλιά*); M = 100% vs. M = 98% [$t_1(19) = 2.52$; $t_2(23) = 1.00$]. For the CS task, the percentage of correctly inflected verbs in

singular number both after L1 (The tree *είναι πράσινο*) and after L2 (Το δέντρο *is green*) singular subject nouns was 99%, ts < 1. The difference between correctly inflected verbs in plural number after L1 (The books *είναι παλιά*) and after L2 (Τα βιβλία *are old*) was not significant either; *M* = 98%, ts < 1.

Comparing across language tasks for correct responses when the source language was the L1, the difference between singular single-language (*The tree is green*) and CS (The tree *είναι πράσινο*) conditions was not significant; *M* = 100% vs. *M* = 99% [$t_1(19) = 1.45$; $t_2(23) = 1.00$]. The difference between plural single-language (*The books are old*) and CS (The books *είναι παλιά*) conditions was significant in the analysis by participants whereby more correct responses were given in single-language than in code-switching; *M* = 100% vs. *M* = 98%, respectively [$t_1(19) = 2.18$; $t_2(23) = .57$]. When the source language was the L2, the percentage of correctly inflected verbs both after singular single-language and after singular CS conditions (*Το δέντρο είναι πράσινο*/Το δέντρο *is green*) was 99%, ts < 1. The percentage of correctly inflected verbs both after plural single-language and plural CS conditions (*Τα βιβλία είναι παλιά*/Τα βιβλία *are old*) was 98%, ts < 1. Thus, English-Greek bilinguals' performance on S-V agreement with convergent nouns in Experiment 5 was found to be similar to Greek-English bilinguals' performance in Experiment 4. That is, English-Greek bilinguals did not show difficulty in processing subject nouns whose number was the same across the two languages either in single-language or in CS conditions.

4.9.5.2 Results of Analysis on Divergent Nouns

We also conducted t-tests for divergent subject nouns to compare correctly inflected verbs in the single-language task across languages and within languages. Across languages, the difference between correctly produced verbs following L1 and L2 singular subject nouns (*The hair is short* vs. *Το παντελόνι είναι μαύρο*) was not significant; *M* = 92% vs. *M* = 90% [$t_1(19) = .82$; $t_2(23) = 1.29$]. The difference between the two languages for verbs that were produced after plural subject nouns was significant whereby more correctly inflected verbs were produced after L1 (*The trousers are black*) than after L2 (*Τα μαλλιά είναι κοντά*) subject nouns; *M* = 92% vs. *M* = 78% [$t_1(19) = 2.60$; $t_2(23) = 4.91$]. Within languages, the percentage of correctly inflected verbs following L1 singular (*hair*) and L1 plural (*trousers*) divergent nouns was 92%, ts < 1. The difference between correctly inflected verbs following

L2 singular (*παντελόνι*) and L2 plural (*μαλλιά*) divergent nouns was significant: more correct responses were given after singular nouns than after plural nouns; M = 90% vs. M = 78%, respectively [$t_1(19)$ = 2.87; $t_2(23)$ = 6.02]. To summarize the results of single-language completion with divergent nouns, we found that English-Greek bilinguals, similarly to Greek-English bilinguals (Experiment 4), provided more correct responses in their L1 than in the L2, but interestingly, unlike the Greeks, they also showed evidence of L2 influence on L1 production. Thus, 7% of the time English bilinguals would say **The trousers is black* and 8% of the time they would say **The hair are short*. We turn to this finding below. For single-language completion in the L2, English-Greek bilinguals showed greater difficulty in computing plural agreement than singular agreement.

We also conducted t-tests to examine speakers' responses with divergent nouns within each switch direction. In L1-L2 direction, the results of both singular and plural subject noun completions showed that the produced verb tended to acquire the number specification of the L1 subject noun. Thus, after L1 singular subject nouns, more singular than plural inflected verbs were produced in L2 (The hair *είναι κοντό*; 'The hair is short'); M = 73% vs. M = 10% [$t_1(19)$ = 16.09; $t_2(23)$ = 12.69], and after L1 plural subject nouns more plural than singular inflected verbs were produced in L2 (The trousers *είναι μαύρο*; 'The trousers is black'); M = 55% vs. M = 17% [$t_1(19)$ = 7.96; $t_2(23)$ = 9.79]. In L2-L1 direction, after L2 singular subject nouns more singular than plural inflected verbs were produced in L1 (Το παντελόνι *is black*; 'The trousers is black'); M = 64% vs. M = 14% [$t_1(19)$ = 9.96; $t_2(23)$ = 16.60], and after L2 plural subject nouns more singular than plural inflected verbs were produced in L1 (Τα μαλλιά *is short*; 'The hair is short'); M = 58% vs. M = 25% [$t_1(19)$ = 4.65; $t_2(23)$ = 9.14].

The results of code-switching for L1-L2 direction showed that English-Greek bilinguals, similarly to Greek-English bilinguals (but not as often as they), tended to produce a verb that agreed in number with the L1 subject noun. This pattern was found to be even stronger following singular divergent subject nouns (*hair*). Interestingly, although the verb did not acquire the number of the noun in the target language, the suffix that was assigned to the predicate adjective always agreed with the gender of the target noun (e.g., The hair *είναι κοντό*; 'The hair is short-N.SG' for *hair* in Greek is neuter, and not *κοντή*-F.SG or *κοντός*-M.SG). This may be interpreted as evidence that speakers accessed the lemma of the noun in the target language but for some reason (e.g., number mismatch, partial overlap between

concept and form, L1 dominance) they did not apply the corresponding plural inflection to the predicate adjective; rather they opted for the use of a feature from the target language that would not clash with the source language. Moreover, Owens (2005) argues that "when speakers have the choice of an equivalent construction which avoids morphological attachment altogether, this alternative will be chosen".

For L2-L1 direction, we also observed the pattern of L1 number influence on verb-implementation since after an L2 plural divergent noun (*μαλλιά*; 'hair') the produced verb in L1 tended to agree with the L1 singular translation equivalent (e.g., Τα μαλλιά *is short*; 'The hair is short'). However, after an L2 singular divergent noun (*παντελόνι*; 'trousers'), despite some evidence of number interference of the L2 plural counterpart, we did not replicate the considerable size of plural number effect found in Greek-English bilinguals. That is, English-Greek bilinguals in a switch after an L2 singular divergent noun produced a singular verb in L1 in more than half of their responses (e.g., Το παντελόνι *is black*; 'The trousers is black'). (We discuss the reasons for this disparity in the next section).

4.9.5.3 Single-Language Results: Monolinagual vs. Bilingual Mode

More importantly, we conducted independent-sample t-tests to compare the findings from agreement implementation in single-language production in the L2 (Greek) between monolingual mode (Expt. 2) and bilingual mode (Expt. 5). We were interested to see whether the bilingual setting of Experiment 5 might overcome English bilinguals' resistance to L1 influence on single-language completion that we found in Experiment 2 (monolingual mode). Regarding correct responses for S-V agreement with convergent subject nouns, there was no significant difference in performance between the two modes for singular number (e.g., *δέντρο*; 'tree') since the percentage of correct agreement in both modes was M = 99%, ts < 1. For plural number, the difference in correct agreement between the corresponding single-language conditions from the two experiments was significant: performance on single-language completion during the bilingual mode was slightly better than performance on single-language completion during the monolingual mode only in the analysis by participants; M = 98% vs. M = 96% [$t_1(19) = 2.01$; $t_2(23) = 1.08$].

For divergent subject nouns, S-V agreement performance was considerably better when bilinguals had to produce single-language utterances in the monolingual mode (Expt. 2) than when they had to produce single-language utterances in the bilingual mode (Expt. 5), both after singular and after plural divergent nouns. Following singular divergent nouns (*παντελόνι*; 'trousers'), the difference in error occurrence between the two modes was significant; $M = 0\%$ vs. $M = 6\%$ [$t_1(19) = 3.62$; $t_2(23) = 4.18$]. The same was true following plural divergent nouns (*μαλλιά*; 'hair'); $M = 1\%$ vs. $M = 17\%$ [$t_1(19) = 4.17$; $t_2(23) = 4.18$]. The difference in correct responses between the two modes was significant both for singular nouns (e.g., *παντελόνι*; 'trousers'); $M = 96\%$ vs. $M = 78\%$ [$t_1(19) = 4.03$; $t_2(23) = 7.72$], and for plural nouns (e.g., *μαλλιά*; 'hair'); $M = 99\%$ vs. $M = 90\%$ [$t_1(19) = 4.66$; $t_2(23) = 14.07$]. These results replicate the results yielded by Greek-English bilinguals on single-language completion during the monolingual mode (Expt. 1) and the bilingual mode (Expt. 4). That is, correct agreement computation in the L2 was encouraged more in the monolingual mode where bilinguals had to speak entirely in their L2 than in the bilingual mode where apart from single-language completion they additionally had to alternate between their two languages in code-switched production. (Figure 9 shows the proportions of correctly inflected verbs in single-language after L2 singular and plural subject nouns in a monolingual mode setting (not involving CS, Expt. 2), and in a bilingual mode setting (also involving CS, Expt. 5)).

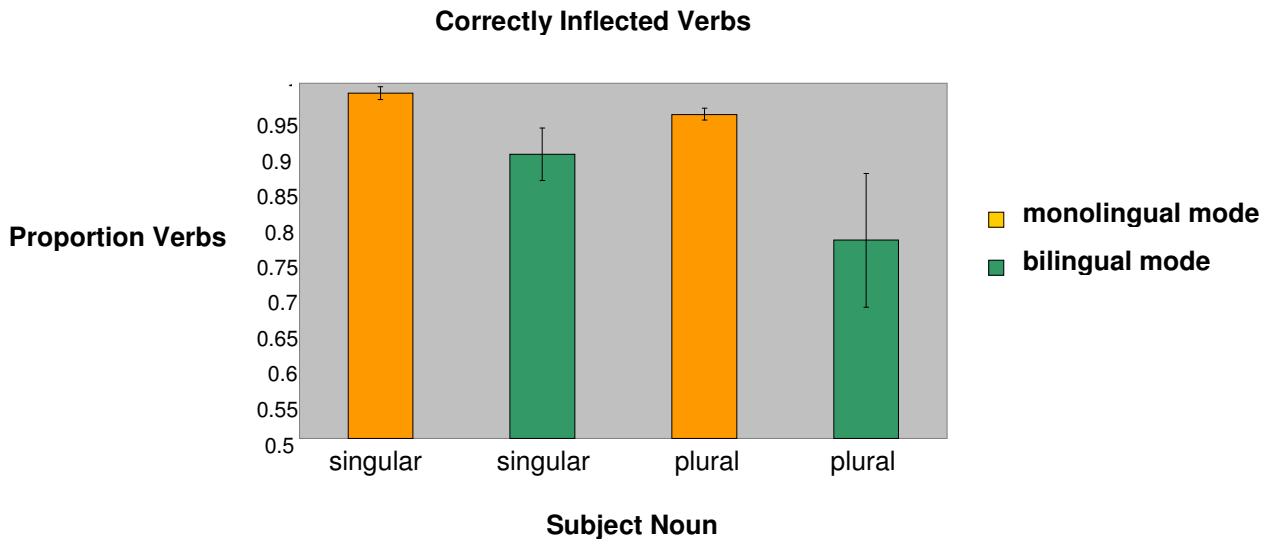

Figure 9. Comparison of correct S-V agreement in L2 (Greek) with divergent nouns by English-Greek bilinguals during monolingual mode of speech (Expt. 2) vs. bilingual mode of speech (Expt. 5).

4.10 Discussion

The findings from English-Greek bilinguals on S-V agreement with convergent nouns showed that the bilingual mode of speech had no effect on correct verb-implementation. However, the results of divergent nouns clearly showed that L1 influence on V-agreement considerably depended on the mode of speech, and that there was a significant increase of influence between single-language completion in the monolingual mode, single-language completion in the bilingual mode, and L2-L1 code-switching. Thus, for L2 plural divergent nouns (*μαλλιά*; 'hair'), there was 1% singular influence of the L1 in strictly L2 single-language completion (monolingual mode) (**Τα μαλλιά είναι κοντό*; 'The hair is short'), 17% singular influence during single-language completion in the bilingual mode where CS also took place (**Τα μαλλιά είναι κοντό*; 'The hair is short'), and 58% singular influence in L2-L1 CS (Τα μαλλιά *is short*; 'The hair is short'). For L2 singular divergent subject nouns (*παντελόνι*; 'trousers'), there was no evidence of L1 plural influence in single-language completion in the monolingual mode, but there was 6% plural influence in single-language completion in the bilingual mode (**Το παντελόνι είναι μαύρα*; 'The trousers are black'), and 14% plural influence in L2-L1 CS (Το παντελόνι *are black*; 'The trousers are black'). (See Figures 10 and 11 for a comparison of L1 number influence after L2 singular and plural divergent nouns during single-language completion in the monolingual mode, single-language completion in the bilingual mode, and in L2-L1 CS).

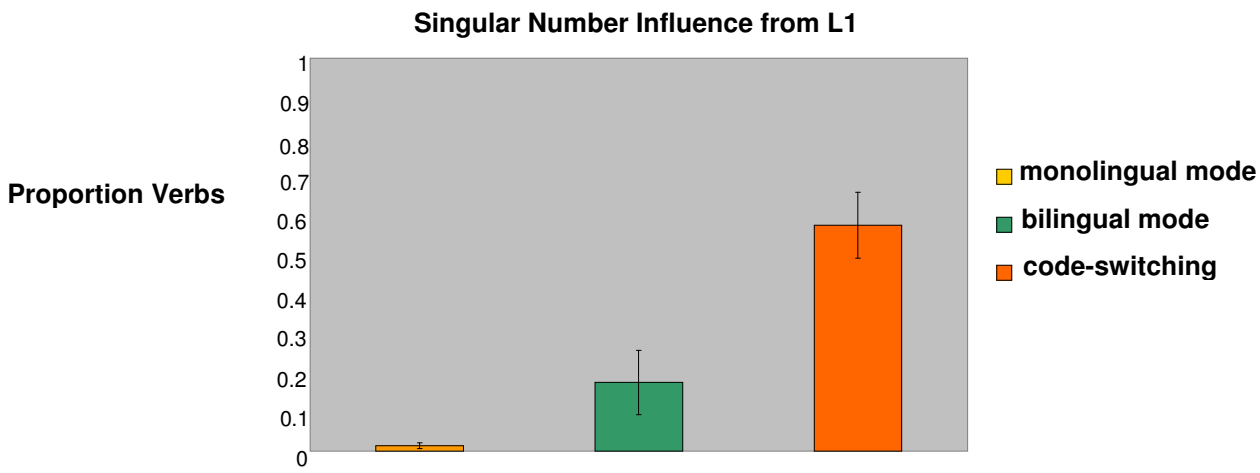

Figure 10. Singular number influence of the L1 on verb-agreement after L2 plural divergent nouns (*μαλλιά*, 'hair' in Greek) during single-language production in the monolingual mode (Expt. 2), single-language production in the bilingual mode (Expt. 5), and during L2-L1 code-switched production (Expt. 5) by English-Greek bilinguals.

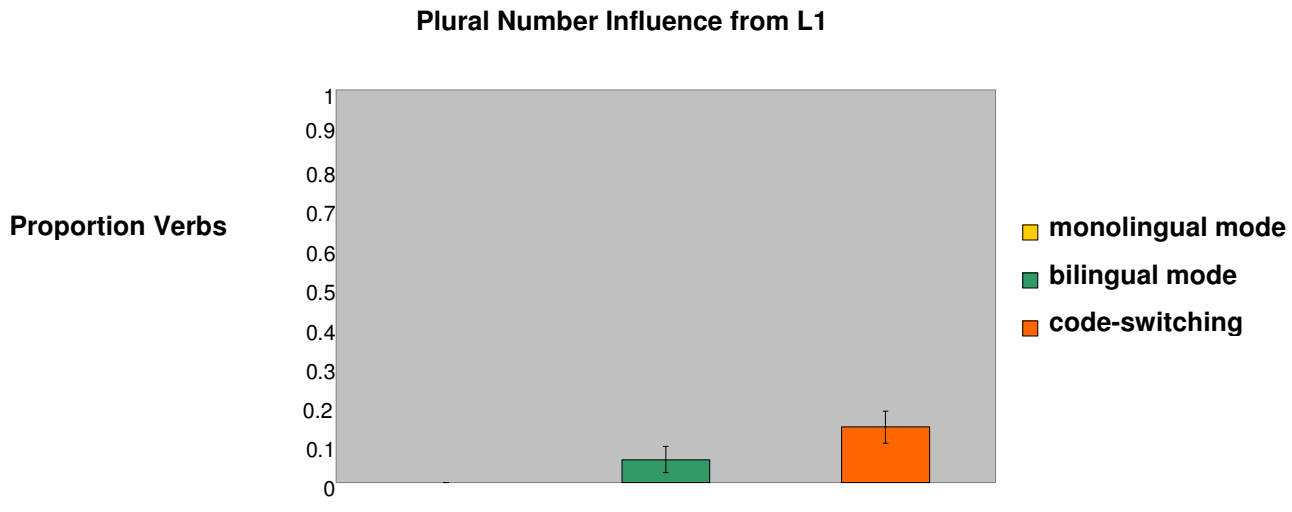

Figure 11. Plural number influence of the L1 on verb-agreement after singular divergent nouns (*παντελόνι*, 'trousers' in Greek) during single-language production in the monolingual mode (Expt. 2), single-language production in the bilingual mode (Expt. 5), and during L2-L1 code-switched production (Expt. 5) by English-Greek bilinguals.

4.10.1 Comparison between English-Greek and Greek-English Bilinguals' Performance in the Bilingual Mode

English-Greek bilinguals' performance in the bilingual mode (Expt. 5) compared to Greek-English bilinguals' performance in the same mode (Expt. 4) was found to be similar both in single-language and in CS for subject nouns whose grammatical/notional number was the same across the two languages (convergent nouns). For subject nouns whose number diverged between English and Greek, we observed the following interesting effects: first, for single-language completion, not only was there influence of the number of the L1 on L2, as was the case with Greek-English bilinguals, but also of the number of the L2 on L1, unlike Greek-English bilinguals. That is, English-Greek bilinguals were found to be vulnerable to number influence of their second language (Greek) when they produced utterances in their native language (English). One possible explanation for this contrasting finding could be that the nature of the sentence-completion task, which demanded co-activation of the two language systems, created a considerable cognitive overload, and thus more possibilities of occurrence of errors (e.g., Fayol et al., 1994). This is assumed especially when the competition is between two language systems of rich and relatively poor morphology, respectively.

A second finding in Expt. 5 similar to Expt. 4 was that in CS when the language of the subject noun was bilinguals' L1 (L1-L2 switch direction), the verb that was produced in the other language tended to agree in grammatical number with the L1 subject noun. However, for L2-L1 switch direction, the performance of the two bilingual groups was not similar overall. Namely, although Greek-English bilinguals displayed strong influence of the number of their L1 on subject-verb agreement both after L2 singular and plural divergent nouns, English-Greek bilinguals demonstrated the effect of significant L1 influence only after L2 plural divergent nouns (*μαλλιά*; 'hair'). We interpret this finding in the following way: for English-Greek bilinguals, when the language of the subject noun was the L2 (L2-L1 switch direction), influence of the L1 was stronger in sentences where the number of the subject noun diverged between the two languages both grammatically and notionally. Thus, 14% of L1 plural number influence was found after an L2 singular divergent noun (*παντελόνι*; 'trousers') which differed from the English translation equivalent only in grammatical number but was considered as having the same (singular) notional number. In contrast, a considerable 58% of L1 singular number influence was found after L2 plural divergent nouns (*μαλλιά*; 'hair'), which not only were grammatically different from the English counterparts but were also considered notionally different, since the notional mean rating that was given for this type of nouns by English-Greek bilinguals was $M = 2.38$ when it was seen in Greek, but $M = 1.83$ when it was seen in English; [$t_1(19) = 24.74$; $t_2(23) = 2.85$].

Thus, if we assume that subject nouns which are "double-marked" (i.e., both morphologically and notionally) as divergent from their translation equivalents may accentuate the clash between the two languages, then it is plausible that the production system might minimize the agreement process strain during CS by taking into account the most salient feature from the contact of the two languages, that is, the feature that is most salient either due to divergence or due to convergence. The *agreement convergence* account can explain the difference of L1 influence for each number of divergent nouns as well as the behavior of both the Greek-English and English-Greek bilingual groups. In contrast, accounts in which the late age of acquisition of a second language may affect in a certain direction the way bilinguals represent and make use of the linguistic features of their L2 (the *critical period effects hypothesis*) (Johnson & Newport, 1989; Silverberg & Samuel, 2004; but see Hakuta, Bialystok, & Wiley, 2003), or in which English-Greek bilinguals employed a strategy of responding by default in singular

number regardless of the subject noun's number specifications, thus producing verbs in singular both after singular and after plural nouns, is not supported by the evidence from Greek-English bilinguals.

To summarize, the findings presented so far from the comparison between Greek-English bilinguals' performance (Expt. 4) and English-Greek bilinguals' performance (Expt. 5) on code-switching production with divergent nouns allowed us to test two of the hypotheses we formulated in the introduction of the thesis of how agreement may be computed in a bilingual discourse environment. We speculated that since both languages are necessarily activated to engage in a task of alternating turns in language production, control of agreement should result from either the subject noun (source language) or from its translation equivalent (target language) (see Table 24). The findings from both groups of bilinguals led us to conclude that S-V agreement in code-switching seems to be resolved taking into account all the available information from the two activated language systems. However, the use of that information appears to be selective depending on the direction of the switch: when the source language of the switch is bilinguals' L1, then L1 grammatical features seem to prevail on verb construction. When the source language of the switch is bilinguals' L2, verb production tends to be driven either by the morphological/notional feature that prevails the most in the contact between the switched languages (the case of Greek-English bilinguals), or by the feature that is mostly shared between the two languages (the case of English-Greek bilinguals).

Agreement with the Number of the L1				
	Greek-English Bilinguals		**English-Greek Bilinguals**	
Switch Direction	**L1 Singular**	**L1 Plural**	**L1 Singular**	**L1 Plural**
L1-L2	√	√	√	√
L2-L1	√	√	√	X

Table 24. Patterns of V-Agreement for Divergent Nouns in CS by Greek-English & English-Greek Bilinguals.

4.11 Chapter Summary

In the present chapter we examined the effects of number divergence across languages and bilingual mode of speech on subject-verb agreement implementation. In Experiment 3, Greek-English bilinguals completed sentences with convergent subject nouns while alternating between their languages in single-language and code-switching conditions and with divergent subject nouns in code-switching conditions only. In a full design in the following experiments (4 and 5), Greek-English and English-Greek bilinguals respectively apart from single-language completion in the L2 also performed on single-language completion in the L1 as well as on code-switching in both switch directions (L1-L2 and L2-L1) (bilingual mode).

For single-language completion in the L2 following convergent subject nouns, the results replicated those of the corresponding single-language conditions of the monolingual mode experiments (1 and 2) whereby S-V agreement proceeded unimpeded. There was no effect of the bilingual mode and consequently of influence of language alternation on verb-agreement in bilinguals' L2. According to our prediction, following divergent subject nouns both groups of bilinguals showed evidence of L1 influence replicating the patterns of influence observed in the monolingual mode experiments, yet in a more enhanced degree. Namely, for Greek-English bilinguals, the effect of the bilingual mode after L2 singular nouns (*hair*) led to a drop in correct S-V agreement from 95% to 65% and to an increase of agreement errors from 4% to 15%. After L2 plural nouns (*trousers*), correct responses dropped from 96% to 89% and agreement errors increased from 1% to 5%. For English-Greek bilinguals, after L2 singular nouns (*παντελόνι*; 'trousers'), correct verb-agreement dropped from 99% to 90%, while agreement errors increased from 0% to 6%. Following L2 plural nouns (*μαλλιά*; 'hair'), correct responses dropped from 96% to 78% and errors increased from 1% to 17% (see Table 25).

Greek-English Bilinguals			English-Greek Bilinguals	
Convergent				
	Sg *tree*	100 (0)	Sg *δέντρο*	99 (0)
	Pl *books*	99 (0)	Pl *βιβλία*	98 (0)
Divergent				
	Sg *hair*	65 (15)	Pl *μαλλιά*	78 (17)
	Pl *trousers*	89 (5)	Sg *παντελόνι*	90 (6)

Table 25. Greek-English and English-Greek bilinguals' performance on single-language completion in the L2 during the bilingual mode. We report the percentages of correct S-V agreement, and in brackets the percentages of L1 number influence. (Singular = Sg; Plural = Pl).

For single-language completion in the L1 following convergent subject nouns, both groups of bilinguals were 100% correct in their responses. Following divergent subject nouns, the responses of Greek-English bilinguals showed no effect of the bilingual mode of the experiment, yet English-Greek bilinguals showed influence of their L2 since there were 8% agreement errors after L1 singular nouns (*hair*) and 7% errors after L1 plural nouns (*trousers*) (see Table 26).

Greek-English Bilinguals			English-Greek Bilinguals	
Convergent				
	Sg *δέντρο*	100 (0)	Sg *tree*	100 (0)
	Pl *βιβλία*	100 (0)	Pl *books*	100 (0)
Divergent				
	Sg *παντελόνι*	99 (0)	Sg *hair*	92 (8)
	Pl *μαλλιά*	98 (0)	Pl *trousers*	92 (7)

Table 26. Greek-English and English-Greek bilinguals' performance on single-language completion in the L1 during the bilingual mode. We report the percentages of correct S-V agreement, and in brackets the percentages of L2 number influence.

Regarding the results of the code-switching conditions with convergent nouns, Greek-English bilinguals yielded fewer omissions in the L2-L1 direction, that is, when the target language was the L1, than in the opposite direction. For English-Greek bilinguals, sentence completion was equally good for both switch directions. Following divergent nouns, in L1-L2 direction, both groups of bilinguals showed a strong tendency to make the verb agree with the number of the source (native) language. The pattern of L1 dominance was present for Greek-English bilinguals also in L2-L1 direction. For English-Greek

bilinguals this pattern was yielded in L2-L1 direction only in sentence completion following plural nouns (*μαλλιά*; 'hair'), but not following singular nouns (*παντελόνι*; 'trousers'). (See below for further discussion).

The findings from bilingual sentence production where the mode of speech and the syntactic properties of two languages were manipulated can be summarized in the following three points: (i) there is *parallel activation* of the two language systems not only when a bilingual alternates between her two languages in the bilingual mode but also when she produces utterances entirely in her L2 (monolingual mode); (ii) *L1* syntactic properties also exert their influence on CS in both switch directions, especially when the number of the subject noun differs across languages both morphologically and notionally, and (iii) there is *agreement convergence* in L2-L1 direction when a subject noun shares some number features with its translation equivalent. In the concluding chapter of the thesis, we discuss in more detail the implications of these findings for agreement and bilingualism.

CHAPTER 5

Sentence Production in the Bilingual Mode: Pronoun-Agreement

5.0 Chapter Overview

In this chapter we investigate the effects of language interaction on agreement with tag pronouns. Having established in the previous chapters that verb-agreement can be influenced by the bilingual mode of discourse context as well as the divergent number properties of subject nouns across two languages, we currently seek to examine how these two factors may affect pronoun-agreement in tag questions (e.g., *The trousers of the boy got stained*, *didn't they?*). In Experiment 6 Greek-English bilinguals, and in Experiment 7 English-Greek bilinguals perform on tag-question production in both their languages following L1 and L2 noun phrases in single-language and CS conditions (e.g., *The birthday of the girl got organized, didn't it?* vs. Τα γενέθλια του κοριτσιού οργανώθηκαν, *didn't it?*). Regarding tag-switching conditions, we note that from the perspective of the Matrix Frame Model, Myers-Scotton argues that "the tag question can be seen as a reduced clause, and it is very acceptable to code-switch for a new clause" (personal communication, November 28, 2006). Our focus in these experiments is on tag-question production only in English (L2 for the Greek-English bilinguals and L1 for the English-Greek bilinguals), because tag-questions in Greek are not inflected for number. We seek to examine (a) whether there is number influence of the non-target language, and (b) what kinds of patterns are yielded in code-switched tag questions.

In Experiments 8 and 9 with Greek-English and English-Greek bilinguals respectively, we further seek to confirm whether the effects observed in the preceding experiments with tag questions are due to the interaction of the syntactic number divergence of the subject nouns across the two languages and not due to any other semantic correlates (e.g., an item belonging to a category considered more or less singular/plural than another). Thus, in the last two experiments of the thesis, both groups of bilinguals perform on tag-question production as previously, yet each divergent subject noun of the reference clause in each language is now replaced and matched with another semantically related convergent subject noun. The focus of interest is on responses during tag-question formation in the related versus the unrelated (control) condition.

5.1 Tag Questions

So far we have examined language interaction effects on verb-agreement with nouns. In the last experimental chapter of the thesis we look at pronoun-agreement to gain more insight into this syntactic process while contrasting two syntactic categories (nouns vs. pronouns) that have many features in common: (i) a pronoun that substitutes for a noun has to agree with its antecedent in gender, number, and person; (ii) the same distinction between singular and plural number that applies to nouns applies to pronouns as well.

In English, there are many manifestations of the so-called 'tag questions' (e.g., *Open the window, will you? It doesn't happen often, does it? She rarely goes out, does she?*, and so on) and are usually defined as "a statement to which a question tag (an auxiliary verb and a pronoun) has been added" (*Collins Cobuild English Grammar*, 1994). They are most often used in oral speech to confirm the correctness of a speaker's thought or to check whether the addressee has the same opinion or view with her interlocutor's statement (Cattell, 1973; Hudson, 1975; Ogawa, 1976).

Despite the pause that usually precedes tag articulation that might be considered as evidence for a separate argument in sentence formulation, both clause and tag are produced in the same utterance (Näsślin, 1984). More particularly, regarding the syntactic operations of tag formation, the processes that precede and include tag-question formation can be sketched in the following way: first, a declarative sentence is formed upon speakers' intentions to say who does what to whom, and hierarchical structures are built, for example a noun phrase and a predicate. The subsequent formation of a tag question (as with any kind of questions) is signalled with the retrieval of a *pragmatic marker* from the conceptual representation which dictates the insertion of an auxiliary and subject-auxiliary inversion (Kempen & Hoencamp, 1987). It is assumed that the pronoun that refers to the subject of the NP and the auxiliary of the reference clause are often used in tag questions with reverse polarity (e.g., affirmative clause – negative tag, and vice versa) (Klima, 1964; Armagost, 1972). The so-called negative tag questions are frequently used in everyday speech (Culicover, 1992) and are the ones we elicited in our experiments.

5.2 Pronoun Representation, Production, and Agreement

In their paper, Schmitt, Meyer, and Levelt (1999) describe the process of pronoun retrieval and production, and distinguish among the following stages: first, the speakers decide upon the retrieval of lexical concepts that correspond to pronouns depending on the discourse context and whether the focus is on pronoun versus noun production. This information (which is communicated through nodes) is then grammatically encoded through activation of the appropriate lemmas that carry all the necessary information for the semantic, grammatical and syntactic formation of words (e.g., number, gender, and person) (Levelt, 1989). For instance, in languages with grammatical gender, gender information that is activated with the activation of a noun lemma will be used for the selection of the appropriate pronoun (Roelofs, Meyer, & Levelt, 1998; Jescheniak, Schriefers, & Hantsch, 2001). The same will happen in the case of number and person specification as a pronoun must agree with its antecedent in all these aspects. As soon as the intended pronoun is selected, its phonological encoding is realized in the same way as with nouns.

5.2.1 Semantic vs. Syntactic Influences on Pronoun-Agreement

In many languages, such as the languages in our research (English and Greek), pronouns agree in number, person, and gender with their antecedent nouns or NPs. With respect to studies on pronoun agreement, Meyer and Bock (1999) sought to test certain hypotheses about how pronouns are selected during language production. According to the *lexical hypothesis*, pronoun processing may take place through the selection of a phonologically intact verbatim trace of the antecedent referring expression, that is, through a representation of lexical features associated with potential antecedents from the discourse context. Alternatively, following the *conceptual hypothesis*, pronoun processing may take place at conceptual level whereby as soon as conceptual information about the referent is established (deictic reference) all relevant features and linguistic properties corresponding to the referent are specified, leading to the selection of the appropriate pronoun. Finally, the *tag hypothesis* integrates features from both the previous accounts postulating a joint representation of the properties of pronouns from the conceptual level and the surface level whereby there is combination of information about the conceptual referent and retrieval of its grammatical features with the help of memory traces.

To explore the above hypotheses, Meyer and Bock (1999) investigated gender agreement for demonstrative and relative pronouns by manipulating the gender of antecedents and local nouns as well as the type of determiners that accompanied them. Thus, gender match vs. gender mismatch and overt gender (gender marked definite determiners) vs. covert gender (gender unmarked indefinite determiners) were examined. Dutch speakers read aloud sentences displayed on a computer screen that were followed by an adjective which they had to use to add a second sentence (Expt. 1) or insert a relative clause (Expt. 2). For instance, they would read a sentence such as *Look, there's a potato lying next to a swimsuit* in Dutch, followed by a Dutch adjective, for example, *cooked*, and they would either produce *It is cooked* or *…that is cooked*. The main questions of interest were (i) whether the produced pronoun would reflect the gender of the antecedent (*potato*) or whether it would be influenced by the gender of the local noun (*swimsuit*), and (ii) whether or not speakers rely on an antecedent's overt gender cue (e.g., determiner) to select the gender of an anaphoric or relative pronoun. The results showed more pronoun agreement errors when the head noun and the local noun mismatched in gender than when not. In addition, overt gender marking did not have an effect in error rate in comparison to covert gender marking, and fewer errors were made when the antecedent and pronoun where in the same sentence than otherwise. The authors interpreted this as evidence for the *lexical hypothesis* by arguing that the observed influence on the pronoun's gender occurred during the course of representation in memory of the grammatical features of lexical items that denoted the referent in the discourse context. In other words, the results provided evidence for an account whereby pronouns' selection was based on the lexical features of an antecedent and not on an overt morphological representation (against the *tag hypothesis*, but see Schmitt et al., 1999).

In another study, Bock et al. (1999) examined the effects of mismatched features between the conceptual and grammatical number of collective nouns on pronoun agreement. The authors manipulated the number of the head noun whereby it could be notionally and grammatically singular (e.g., *The actor in the soap opera rehearsed/watched*), notionally and grammatically plural (e.g., *actors*), and notionally plural but grammatically singular (e.g., *cast*). The number of the local noun (singular vs. plural) was also manipulated. Participants were instructed to read aloud any of these sentences and provide either a tag pronoun (e.g., … *didn't he?*) or a reflexive pronoun (e.g., … *himself*). The prediction for the first two conditions was that number agreement should be implemented in the same way since there was no clash

between notional and grammatical number. However, for collective head nouns, pronoun agreement should show effects of notional number influence from the head noun. This prediction was based on the assumption that pronouns are susceptible to conceptual factors as it has been suggested in the literature (in contrast to verbs which are considered to be prone to grammatical influences; see Bock et al., 1999 study in *2.5.1.1 Semantic vs. Syntactic Influences on Verb-Agreement*). Bock et al. (1999) were also interested to see whether difference in the nature of pronouns would lead to differential results. That is, as tag pronouns do not have their antecedent within their own clause in comparison with reflexive pronouns, this might make the latter behave similarly to verbs and not display evidence of conceptual influence during the processing of agreement. The results showed that reflexives and tags behaved in the same way. That is, after collective head nouns both categories of pronouns tended to agree with the notional number of their controllers. The manipulation of the number of the local noun yielded the well-known plural attraction effect whereby pronouns agreed in number with the plural local noun after a singular head noun (in this respect behaving similar to verbs). The authors interpreted these results by arguing that number specification for pronouns can be retrieved from the intended message because pronouns refer to a non-explicit antecedent (*notional hypothesis*). In contrast, verbs seem to acquire their number feature from the utterance's form since they are almost always accompanied (in English at least) by an explicit subject (*inflection hypothesis*) (see also Bock & Eberhard, 1993).

In a more recent study, Bock, Eberhard and Cutting (2004) manipulated the notional and grammatical number properties of head nouns and local nouns in a sentence-completion task to examine further whether tag pronouns and verbs acquire their number specifications from the same source or not. This study was based on Bock et al. (1999) but was extended to include more conditions, thus creating a comparable environment for pronoun and verb agreement. According to previous findings, pronouns were expected to be more sensitive to the notional number of their controllers than verbs (e.g., Corbett, 1979, 2000; Bock et al., 1999). Yet for the conditions in which there was mismatch between notional and grammatical number for head nouns, the authors did not exclude the possibility of pronouns and verbs behaving the same if they both acquired their number specifications from the same source as the head nouns. For the conditions in which there was mismatch between notional and grammatical number for local nouns, pronouns and verbs were both predicted to display the same plural attraction effect.

The results of Experiment 1, in which singular and plural number was manipulated in head as well as local-noun positions in verb-eliciting NPs (e.g., *The key to the cabinets*), and in pronoun-eliciting sentences (e.g., *The key to the cabinets disappeared*), showed that plural attraction effects were the same for pronoun and verbs. Yet pronouns differed from verbs regarding singular attraction effects whereby pronouns were more prone to be singular after singular local nouns and plural head nouns than verbs were. In other words, speakers more often produced singular pronouns than singular verbs regardless of the local noun. In Experiment 2, in which the notional and grammatical number of the local nouns was manipulated (individual nouns vs. collective nouns) (e.g., *The record of the player/players (improved) vs. The record of the team/teams (improved)*), the plural attraction effect of Experiment 1 was replicated both for pronouns and verbs. The notional number of singular collective local nouns did not have an impact on either pronouns' number or on verbs' number. Grammatically plural collectives affected pronouns and verbs equally. In Experiment 3, the same nouns that were tested in local position in Experiment 2 were now tested in head position. Strikingly enough, when singular collectives were placed in head-noun position, pronouns tended to be plural much more often than verbs, regardless of the number of the local noun.

In Experiment 4, in which unitary and distributive items were tested in head-noun position (e.g., *The letter from the lawers* vs. *The picture on the postcards*), pronouns were more likely to be plural after distributive readings than verbs were. Finally, in Experiment 5, the notional and morphological features of local nouns were tested (e.g., *The drawer for the needles (jammed)* vs. *The drawer for the tweezers (jammed)*. The results showed that more plural agreement was yielded both for pronouns and verbs following morphologically and notionally plural local nouns (*needles*) than following morphologically plural but notionally singular local nouns (*tweezers*). Plural attraction effects were also the same for pronouns and verbs. Bock and colleagues argued that these findings provided support that pronouns are more likely to be influenced by the notional properties of their controllers, whereas verbs are more likely to be influenced by the grammatical properties of their controllers when acquiring their *initial* number in agreement. However, they assumed that there must be a common mechanism for attraction, since attraction effects were found to be the same both for pronouns and verbs. Thus, they concluded, attraction seems to occur at a late point in structural integration.

Bock et al. (2001) and Eberhard et al. (2005) proposed the *marking* and *morphing* model to explain verb-agreement and show in what respect the latter appears to diverge from pronoun-agreement (see also Bock et al., 2004). To begin with, the authors argue that the source of contribution for meaning and for morphology is the same for both grammatical categories. That is, the notional number established at the conceptual level in which the intended message is constructed is common for pronouns and verbs. The difference between them arises during the workings of *marking* and *morphing* mechanisms.

Marking is assumed to take place during the functional assembly of the intended message. This entails that any kind of constraints (notional number variation, gender, person, animacy) is posed by the message. Thus, number specifications of the referent in mind are built for the subject noun phrase by recruiting the appropriate elements from the lexicon (formal word properties) and syntax (function assignment) (this is a mapping between a message representation and lexical-grammatical representation).

Morphing binds lexical and structural forms together and helps in the preparation of the phonological construction of the utterance (i.e., constituent assembly) (this is a mapping between lexical-grammatical representation and morphological representation). Here, any kind of constraints (morphophonology, phrase structural properties) is posed by the lexicon and syntax. It is during this stage the agreement process is realized. Verbs acquire their number from the reconciled number of the entire subject noun phrase via control. That is, the subject controls verb agreement so that the subject number which has been established according to lexical specifications is passed directly to the verb (but see e.g., Vigliocco et al., 1996a who argue that the verb can acquire its number specification directly from the message-level representation). On the other hand, personal pronouns (bearing a number of their own) acquire number specification via concord, that is, as a result of co-reference with the subject-noun phrase, which explains why one should expect the grammatical number of pronouns to reflect notional number in contrast to the grammatical number of verbs.

In *attraction*, it is hypothesized that both pronouns and verbs "fall victim" to the workings of morphing to reconcile the grammatical number of morphemes. That is, what is assumed in this case to influence pronoun-agreement in the same way as verb-agreement is the stage number reconciling takes

place. Eberhard et al. (2005) argue that if the number of the pronoun phrase is reconciled with the number of the antecedent before the pronoun is morphologically formulated, this entails that the pronoun's antecedent and the verb's controller is the same, thus the same grammatical influences can be exerted to both pronouns and verbs. Therefore, attraction errors should occur in a similar way for pronouns and verbs. This would occur if the plural features of a non-intended controller (local noun) won the competition for control against the features of the intended controller (subject noun) when agreement features were transmitted to the target (verb or pronoun).

5.2.1 Summary

In summarizing the findings from the reviewed studies on pronoun-agreement, there are many interesting observations we can make. First, the effects that were displayed for nouns in S-V agreement (see *2.5.1.1 Semantic vs. Syntactic Influences on Verb-Agreement*) were also displayed for pronouns. That is to say, collective nouns' plural notional number tended to affect verb and pronoun agreement only when these nouns were in head noun position. Second, plural attraction effects were replicated for pronouns both when there was a singular head noun - plural local noun mismatch, and when there was a collective head noun - plural local noun combination. Regarding the overall influence of local nouns on verb and pronoun agreement, it was showed that it is the morphology rather than notionality that can affect agreement processing of both categories. Third, the distance of a pronoun from its antecedent (whether they are both in the same clause or not) was not found to affect pronoun-agreement. Fourth, distributivity effects were also replicated for pronouns, although the tendency for plural agreement was stronger for pronouns than for verbs.

Comparing the behaviour of pronouns to verbs we were provided with evidence to support the assumption that pronouns are more likely to be controlled by the conceptual number of the controller, and thus be prone to semantic agreement, whereas verbs by the grammatical number of the controller, and be prone to syntactic agreement (see Bock et al., 2006, for a recent review). It has been argued that the reason why pronouns tend to undergo semantic agreement is because they can relate to a referent from the discourse context, as in the example *Votre Majesté partira quand elle voudra* ('Your Majesty will leave when she wishes', French: quoted in Corbet, 2003) in which the feminine pronoun is used

although it is the king who is addressed. Verbs, on the other hand, having no number of their own cannot but inherit the number of the subject noun with which they correlate highly. This assumption is also supported by studies in which certain semantic variables (e.g., collectivity and distributivity) were manipulated in head noun position and showed that pronouns were sensitive to the notional number of the controller in comparison to verbs that acquired the head noun's grammatical number (e.g., Bock et al., 1999; Bock et al., 2004).

The results of these studies are also in accordance with the Agreement Hierarchy (attributive < predicate < relative pronoun < personal pronoun) proposed by Corbett (1983, 1991, 1998), which shows the difference in sensitivity between verbs and pronouns to notional number. According to the suggested distinction, if semantic agreement is possible in a given position, it will also be possible in all positions to the right. In case where alternative agreement forms are available in two positions, semantic agreement is again more likely in the position to the right than in the position to the left. In addition, Corbett (1979) argues that the greater the distance between a controller and a target, the greater the likelihood that semantic agreement prevails. That is, the agreeing word (verb) is related to a referent (anaphoric head; pronoun) whose own referent (subject of the main clause) is not expressed in the same domain. In this case, pronoun number must be retrieved from the message and therefore pronominal agreement is preferentially correlated with semantic agreement (Hartsuiker & Barkhuysen, 2006, but see Bock et al., 1999).

All in all, although in many aspects pronouns and verbs behave similarly, as it was showed by some of the results, their major difference arises during the operation of mechanisms that are involved in number specification and agreement implementation (marking and morphing). With respect to the phenomenon of "attraction" in S-V agreement, pronouns and verbs have been found to behave similarly, that is, they both appear to be influenced by the morphology rather than notionality of the local noun in complex NPs. Eberhard et al. (2005) explain common attraction behaviour between these two grammatical categories by arguing that during sentence processing, when number reconciling takes place (*morphing*), if the number of the pronoun phrase is reconciled with the number of the antecedent before the pronoun is morphologically formulated, then the pronoun's antecedent and the verb's controller will be the same thus leading to the same grammatical influences on both pronouns and verbs. Therefore,

attraction errors should occur in a similar way for pronouns and verbs. This would occur if the plural features of a non-intended controller (local noun) won the competition for control against the features of the intended controller (subject noun) when agreement features were transmitted to the target (verb or pronoun).

As in the case of verb-agreement, pronoun-agreement has not been studied in bilinguals and the impact of the non-target language on pronoun-agreement in the target language has received no attention in bilingual or code-switching research. In this chapter we seek to address these questions.

EXPERIMENT 6: Tag-Completion in Mixed-Language Production by Greek-English Bilinguals

5.3 Rationale and Predictions

In the present experiment we examine number agreement using the same subjects that we employed in the previous experiments for verbs, now serving as pronominal antecedents. We are interested in the effects of number divergence and bilingual mode on pronoun-agreement. Based on the previous findings from single-language condition, we predict that the bilingual mode setting would enhance number divergence across the two languages, and thus influence tag-question construction, rendering it vulnerable to the underlying number of the non-target language. For divergent nouns, we also predict more correct responses as the discourse context renders the clause less ambiguous than the NPs we used in sentence-completion experiments previously. For convergent nouns, we predict that pronoun-agreement implementation should be unimpeded as was showed in verb-agreement implementation. We also report a grammaticality forced-choice post-test.

5.4 Method

5.4.1 Participants

Twelve Greek-English fluent bilinguals who were native speakers of Greek and spoke English as a second language were paid to participate. They were all postgraduate students at the University of

Edinburgh and had studied English through private tuition which involved grammar, reading and listening comprehension as well as oral practice for a mean of 8 years (SD = 1.04) before moving to the UK. Their average age was 25 years (SD = 2.67). None of them had participated in the previous experiments, but the same procedure of recruitment was applied (see *Participants* specifications of Experiments 1, 3, and 4). As we shall see below, Greek-English bilinguals' highly correct performance on the grammaticality judgement test (M = 97-99% of correct responses for divergent nouns and M = 100% of correct responses for convergent nouns) demonstrated that participants possessed the relevant grammatical knowledge of agreement in the L2.

5.4.2 Materials

We elicited tag questions for two counterbalanced 160-item lists, consisting of positive declarative clauses containing the designated subjects (having a singular prepositional phrase postmodifier after the head) along with passives of the type get + past participle so that the verb lacked overt number morphology. The subject pronoun of the elicited tag referred to the subject of the clause that preceded the tag question and the auxiliary of the tag was mainly 'do' in the past tense which agreed in tense with the verb of the main clause (e.g., *The birthday of the girl got organized, didn't it?*). As the equivalent for any type of tag question in Greek is *Έτσι δεν είναι;* (literally, "so + not + be"; 'isn't it so?') (Joseph & Philippaki-Warburton, 1987) in which there is no overt indication of number, we included it in our experimental design to create a balanced number of tag-question occurrence in speakers' both languages.

There were 80 divergent nouns and 80 convergent nouns. Of the 80 divergent nouns, 40 (20 in singular and 20 in plural) formed four single-language conditions of 10 subject nouns each. In these conditions the tag question should be produced in the same language as the subject noun of the clause. The remaining 40 divergent nouns (20 in singular and 20 in plural) formed four CS conditions of 10 items each. In these conditions the tag question should be produced in the other language of the language of the clause. Each item was seen in one of its two language versions in each list, so that the following conditions were formed: English singular subject noun (Greek plural translation equivalent), Greek plural subject noun (English singular translation equivalent), English plural subject noun (Greek singular translation equivalent), and Greek singular subject noun (English plural translation equivalent).

Of the 80 convergent nouns, 40 (20 in singular and 20 in plural) formed four single-language conditions of 10 subject nouns each: English singular subject noun, English plural subject noun, Greek singular subject noun, and Greek plural subject noun. In these conditions, the tag question should be produced in the same language as the subject noun of the clause. The remaining 40 convergent nouns (20 in singular and 20 in plural) formed four CS conditions of 10 subject nouns each in the following switches: English singular subject noun, English plural subject noun, Greek singular subject noun, and Greek plural subject noun. In these conditions the tag question should be produced in the other language of the language of the clause. All English convergent and divergent nouns paralleled the Greek. The order of presentation was individually randomized across and within lists and there was one convergent noun that preceded or followed any divergent noun. (Table 28 gives sample noun-phrase sets in each of the 8 conditions we were interested in. The complete list of the materials is reported in Appendix D).

5.4.3 Post-Test

5.4.3.1 Grammaticality Judgement

In addition, a grammaticality judgement task was delivered to ensure participants' pronoun-agreement knowledge of tag questions in the L2 (English). We constructed two counterbalanced lists of 160 sentences each; 80 sentences contained divergent nouns and another 80 contained convergent nouns (half of which were singular and half plural). Each noun appeared in a subject noun position in a clause followed by a tag question like the ones we elicited in Experiment 6. Each sentence was presented in two formats, one grammatically correct (e.g., *The hair of the girl got wet, didn't it?*) and one with erroneous pronoun-agreement (e.g., **The hair of the girl got wet, didn't they?*). Participants were instructed to read each pair and circle which of the two sentences they considered grammatically correct. (For results on the Grammaticality Judgement post-test see Table 27, and for materials see Appendix E).

	Divergent Nouns	
	Singular	**Plural**
	A. *The hair of the girl got wet, didn't they?*	A. *The trousers of the boy got stained, didn't they?*
	B. *The hair of the girl got wet, didn't it?*	B. *The trousers of the boy got stained, didn't it?*
Scores (%)	**Singular**	**Plural**
Correct	97	99
Errors	3	1
	Convergent Nouns	
	Singular	**Plural**
	A. *The tree in the garden got sold, didn't it?*	A. *The books in the library got stolen, didn't it?*
	B. *The tree in the garden got sold, didn't they?*	B.*The books in the library got stolen, didn't they?*
Scores (%)	**Singular**	**Plural**
Correct	100	100
Errors	0	0

Table 27. Example sentences from the grammaticality judgement task and results (%) for divergent & convergent nouns by Greek-English bilinguals.

Responses were calculated for correct pronoun-agreement after convergent and after divergent subject nouns and we conducted two-paired sample t-tests for singular and plural number. The results showed a significant difference between the two types of nouns for singular number but not for plural number. Namely, for singular pronoun-agreement after convergent and after divergent subject nouns more correct responses were yielded in the former than in the latter; M = 100% vs. M = 97% [$t_1(11)$ = 3.55; $t_2(19)$ = 2.99]. That is, no errors were yielded for L2 singular nouns whose number was the same in the L1 (e.g., *The tree in the garden got sold, didn't it?*), but there were 3% errors for L2 singular nouns whose number was plural in the L1 (e.g., **The hair of the girl got wet, didn't they?*). The difference between convergent and divergent nouns for plural pronoun-agreement was not significant; M = 100% vs. M = 99%, respectively [$t_1(11)$ = 1.92; $t_2(19)$ = 1.83]. That is, Greek-English bilinguals identified an L2 plural convergent subject noun sentence correctly (e.g., *The books in the library got stolen, didn't they?*) as often as an L2 plural divergent subject noun sentence (e.g., *The trousers of the boy got stained,*

didn't they?). Thus, the results of the grammaticality judgement confirmed Greek-English bilinguals' satisfactory knowledge of agreement in the L2.

5.4.4 Procedure

Participants were seated at a computer in a booth and were instructed to read aloud the sentence that would be displayed within a blue or red coloured square at the centre of the screen, and add a tag question in the appropriate language depending on the colour of the square; a blue square would be equivalent to 'make a tag question in Greek', whereas a red square would be equivalent to 'make a tag question in English'. Finally, speakers were asked to perform as fast as possible and press the spacebar for the experiment to start. The session began with 4 practice trials of convergent nouns; two of which were in singular (one in CS and one in single-language) and another two were in plural (one in CS and one in single-language). None of the items used was included in the experiment. A fixation cross was always shown at the centre of the computer screen for 1500 ms prior to target NP presentation whose display lasted for 4000 ms. Each session lasted about twenty minutes. All answers were recorded and transcribed for further analysis.

5.4.5 Scoring

Participants' responses were assigned to the following scoring categories: responses in *singular* were scored when participants produced a pronoun in singular and responses in *plural* were scored when the produced pronoun was in plural. *Omissions* were scored when no answer was given and *miscellaneous* (misc.) when there were responses that overrode the instructions of the experimental task. Such an example would be the production of a pronoun in the same language as the clause in a CS condition, or the production of a pronoun in a different language than the clause in a single-language condition. The utterance that was first produced even in cases where participants corrected themselves was scored as a valid one.

5.4.6 Design and Data Analysis

A 2 source-language (Greek vs. English) x 2 source-language number (singular vs. plural) x 2 language-task (single-language vs. CS) x 2 source-language noun type (convergent vs. divergent) design was created. All four factors were within-participants. The factors source-language and language-task were within-items, and the factors source-language number and noun-type were between-items. Responses in singular, in plural, omissions and miscellaneous responses constituted the dependent variables. Two analyses of variance with the proportions of the dependant variables, one for participants (F1) and one for items (F2) were carried out. As we were only interested in English tags, we excluded Greek-tag conditions from our analysis.

5.4.7 Results

Percentages of responses in the four scoring categories are shown in Table 28.

Single-Language Condition
Language of Noun Phrase
English (L2)

Subj.-Noun Condition		**Scores in L2** Singular	Plural	Omiss.	Misc.
Conv.	Sg (tree)	92	0	3	5
	Pl (books)	0	93	2	5
Div.	Sg (hair)	78	18	1	3
	Pl (trousers)	6	84	5	5

CS Condition

Language of Noun-Phrase
Greek (L1)

Subj.- Noun Condition		**Scores in L2** Singular	Plural	Omiss.	Misc.
Conv.	Sg (δέντρο)	97	0	0	3
	Pl (βιβλία)	0	92	1	7
Div.	Sg (παντελόνι)	91	1	3	5
	Pl (μαλλιά)	5	84	2	9

Table 28. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Divergent = Div.; Singular = Sg; Plural = Pl).

Application of the scoring criteria for singular and plural pronouns, omissions and miscellaneous responses are reported in Table 29.

Source of variance		**F1** (1,11)	**F2** (1,76)
		F1 value	**F2 value**
Singular	Source-language	10.000***	3.179
	Source-language number	1966.545***	411.329***
	Noun-type	1.244	.738
	SL x SLN	11.779***	367.893***
	SL x NT	1.114	.845
	SLN x NT	22.000***	536.063***
	SL x SLN x NT	1.846	401.772***
Plural	Source-language	14.310***	2.704
	Source-language number	2589.767***	363.406***
	Noun-type	.121	.126
	SL x SLN	6.499**	324.953***
	SL x NT	7.053**	5.077**
	SLN x NT	21.133***	530.861***
	SL x SLN x NT	8.378**	347.281***
Omissions	Source-language	2.047	1.016

	Source-language number	.880	1.293
	Noun-type	1.692	.563
	SL x SLN	1.158	.254
	SL x NT	.512	.000
	SLN x NT	1.158	1.293
	SL x SLN x NT	4.632 (p =.054)	2.287
Miscellaneous	Source-language	2.311	.184
	Source-language number	8.250**	.724
	Noun-type	.026	.073
	SL x SLN	1.138	1.113
	SL x NT	1.692	3.941 (p = .051)
	SLN x NT	.186	.759
	SL x SLN x NT	.478	.619

Table 29. Results of 3-way ANOVAs with the proportions of singular and plural pronouns, omissions and miscellaneous responses (factors: source-language (SL), source-language number (SLN), and noun-type (NT).

5.4.7.1 Results of Analysis on Convergent Nouns

Moreover, we conducted t-tests to compare pronoun agreement for singular and plural convergent subject nouns in single-language and CS conditions; that is, when the target language was always English (L2) but the source language could be either English (single-language condition) or Greek (CS condition; L1-L2 direction). In single-language condition, the difference in correct responses between singular (*tree*) and plural (*books*) subject nouns was not significant; $M = 92$ vs. $M = 93$ [$t_1(11) = .27$; $t_2(19) = .65$]. The results did not yield any significant difference between single-language and CS conditions either for singular subject nouns $M = 92\%$ vs. $M = 97\%$ [$t_1(11) = 1.59$; $t_2(19) = 1.13$] or for plural subject-nouns $M = 93\%$ vs. $M = 92\%$ [$t_1(11) = .32$; $t_2(19) = .81$]. That is, Greek-English bilinguals found equally easy to produce tag questions in single-language (e.g., *The tree in the garden got sold, didn't it?*/*The books in the library got stolen, didn't they?*) as in CS (e.g., Το δέντρο στον κήπο πουλήθηκε, *didn't it?*/Τα βιβλία στη βιβλιοθήκη κλάπηκαν, *didn't they?*).

5.4.7.2 Results of Analysis on Divergent Nouns

In addition, we conducted t-tests for divergent subject-nouns to examine the amount of influence of the number of the non-target language in tag questions in the target language (single-language condition) as well as the patterns of pronoun-agreement in CS condition. The comparison of pronoun-agreement errors between divergent subject noun clauses and convergent subject noun clauses in single-language condition yielded a significant difference in number influence of the non-target language. Namely, 18% plural tag questions were produced following singular divergent subject noun clauses (e.g., **The hair of the girl got wet, didn't they?*), whereas no errors were yielded following singular convergent subject-noun clauses [$t_1(11) = 6.28$; $t_2(19) = 2.63$]. Likewise, 6% singular tag questions were produced following plural divergent subject noun clauses (e.g., **The trousers of the boy got stained, didn't it?*), but no errors were yielded following plural convergent subject noun clauses [$t_1(11) = 3.02$; $t_2(19) = 1.93$]. Regarding the patterns of pronoun-agreement for divergent nouns in CS condition (L1-L2 switch direction), following L1 plural divergent subject noun clauses (*μαλλιά*; 'hair'), there were more plural than singular tag questions in the L2; $M = 84\%$ vs. $M = 5\%$, respectively [$t_1(11) = 14.22$; $t_2(19) = 25.45$]. Following L1 singular divergent subject noun clauses (*παντελόνι*; 'trousers), there were more singular than plural tag questions in the L2; $M = 91\%$ vs. $M = 1\%$, respectively [$t_1(11) = 36.56$; $t_2(19) = 29.39$]. Thus, Greek-English bilinguals tended to produce overwhelmingly a tag question in the L2 that agreed in number with the L1 subject referent.

5.5 Discussion

The findings from pronoun-agreement in tag questions by Greek-English bilinguals' were very similar to those from verb-agreement of the preceding experiments in the following aspects: first, convergent subject nouns did not create any difficulties for pronoun-agreement either in single-language or in CS conditions in comparison to divergent subject nouns whose agreement computation was disrupted by the influence of the divergent number properties of the translation equivalent in the non-target language.

Second, pronoun-agreement was found to be more sensitive to the underlying number of the non-target language when the subject noun of the referent clause was singular (*hair*) and the translation equivalent was plural (*μαλλιά*) than when the subject noun was plural (*trousers*) and the translation equivalent was singular (*παντελόνι*). This finding corroborates our assumption of markedness for Greek-English bilinguals whereby a co-activated plural competitor in the L1 may be strong enough to "attract" its target (be it a verb or a pronoun) into agreeing with its plural number specification (e.g., **The hair are short* or **The hair of the girl got wet, didn't they?*).

Third, in L1-L2 direction that we examined in the present experiment, the L1 provided the syntactic frame pronoun-agreement conformed with. Thus, native language dominance in our experiments has been found to affect both verb- and pronoun-agreement. We argue that L1-L2 switch direction considerably favours L1 influence (especially for Greek-English bilinguals) not only due to frequency of L1 use, but also because there are many overt markers that make L1 feature activation somewhat more "solid" against feature activation of the L2. To illustrate this, in a sentence such as *Τα μαλλιά του κοριτσιού βράχηκαν* ('The hair of the girl got wet'), a Greek speaker is provided with plural number information from three different sources: the inflection of the determiner, the nominal subject and the verb. Although the presence or absence of more than one morphological marker in the NP has not been found to have an impact on S-V agreement in some monolingual studies (Vigliocco et al., 1996b; Meyer & Bock, 1999, but see Hartsuiker et al., 2003), we assume that morphological number agreement plays an important role in the Greek language system because it can be realized overtly in many instances. Thus, Greek speakers might rely considerably on number cues from each available source when computing agreement. (Figure 12 shows the influence of the source-L1 on verb- and pronoun-agreement for divergent nouns in the target-L2 in L1-L2 switch direction by Greek-English bilinguals).

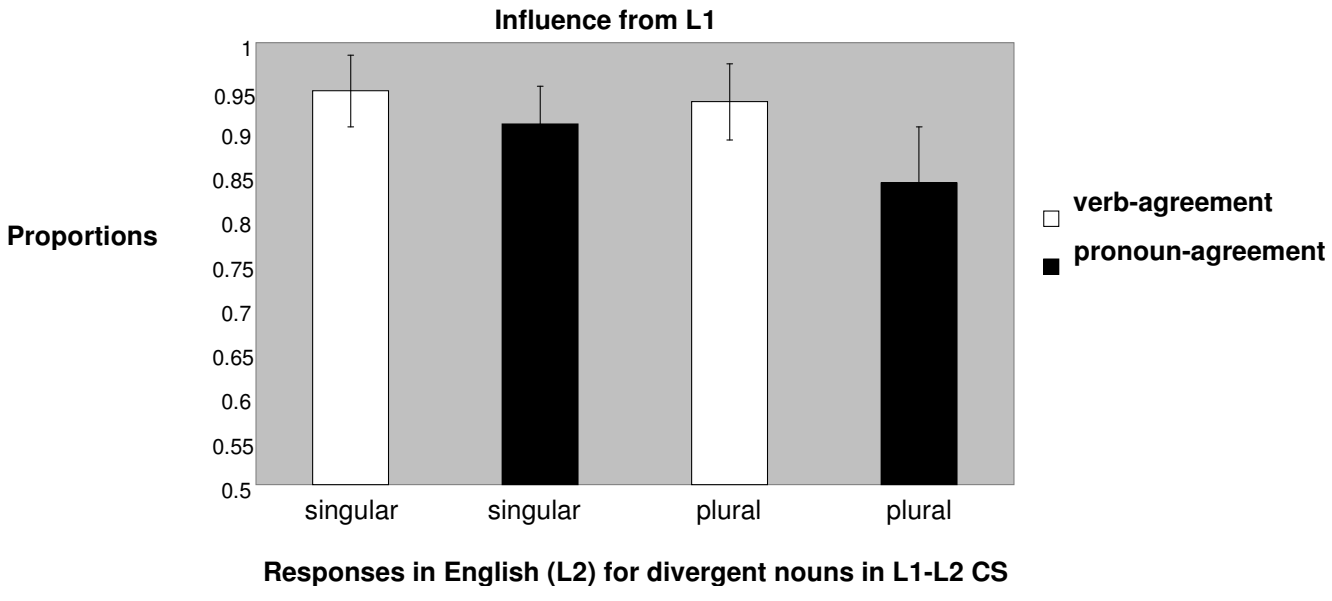

Figure 12. Proportions of verb- (Expt. 4) and pronoun-agreement (Expt. 6) in L1-L2 CS.

Our prediction that more correct responses should be yielded in the current experiment with tag-questions than in the experiment with verb-completions (Expt. 4), as a result of the richer discourse content that was provided in this experiment, was not supported overall. The reason for this may be that Greek speakers having no overt distinction in their native language grammar for singular and plural tag-questions may need to put extra effort when processing a tag-question construction in English (L2). That is, tag-question formation *per se* may pose a certain degree of processing difficulty for which additional semantic information can do little to change that. In the same line, in a S-V agreement study with interrogatives, Franck et al. (2006) found more errors of other kind (e.g., miscellaneous and repetition) in VS inversion than in SV word order (but see Vigliocco & Nicol, 1998), and claimed that the occurrence of other kinds of errors was evidence that the speakers had found the inversion condition somewhat more complex to deal with.

EXPERIMENT 7: Tag-Completion in Mixed-Language Production by English-Greek Bilinguals

5.6 Rationale and Predictions

In Experiment 6 on pronoun-agreement by Greek-English bilinguals we replicated the effects of the bilingual mode setting and number divergence found in the previous experiments on verb-agreement. As we discussed in other experiments of the thesis with Greek-English bilinguals, it is difficult to discern whether the observed L1 influence results from a semantic and/or a morphological contribution of the L1, because in Greek semantics and morphology go hand in hand (see norms in Experiments 3 and 4). However, English-Greek bilinguals have showed that their semantic representation of an item may be detached from its linguistic realization (e.g., Bock et al., 2001; see also norms in Experiment 5 of the thesis). This may allow us to identify whether the forces that drive pronoun-agreement for English-Greek bilinguals are of semantic or morphological nature. Thus, in the present experiment we test English-Greek bilinguals. Apart from the effects of number divergence and bilingual mode, we are also interested in the distance between a controller (subject) and a target (pronoun) (the latter being outside of the previous clause) on pronoun-agreement. Due to different clause membership between tag pronouns and verbs, we might expect different patterns of agreement from the ones yielded in the previous verb-agreement experiments by English-Greek bilinguals, with tag pronouns displaying a tendency towards semantic agreement rather than syntactic agreement (but see Bock et al., 2004).

5.7 Method

5.7.1 Participants

Twelve English-Greek fluent bilinguals who were native speakers of English and spoke Greek as a second language were paid to participate. At the time of the testing, they all lived in Athens and had studied Greek through private tuition which involved grammar, reading and listening comprehension, as well as oral practice for a mean of 4 years (SD = .71) before moving to Greece. Their average age was 46 years (SD = 2.83). None of them had participated in the previous experiments, but the same recruitment procedure was applied as in Experiments 2 and 5 (see corresponding sections).

5.7.2 Materials

Materials were identical to those described in Experiment 6.

5.7.3 Post-Test

5.7.3.1 Grammaticality Judgement

This was the same as in Experiment 6, but for English-Greek bilinguals the post-test examined their knowledge of pronoun-agreement in the L1. (For results on the grammaticality judgement post-test see Table 30).

Divergent Nouns

Singular	**Plural**
A. *The hair of the girl got wet, didn't they?*	A. *The trousers of the boy got stained, didn't they?*
B. *The hair of the girl got wet, didn't it?*	B. *The trousers of the boy got stained, didn't it?*

Scores (%)	**Singular**	**Plural**
Correct	99	100
Errors	1	0

Convergent Nouns

Singular	**Plural**
A. *The tree in the garden got sold, didn't it?*	A. *The books in the library got stolen, didn't it?*
B. *The tree in the garden got sold, didn't they?*	B.*The books in the library got stolen, didn't they?*

Scores (%)	**Singular**	**Plural**
Correct	100	100
Errors	0	0

Table 30. Example sentences from the grammaticality judgement task and results (%) for divergent & convergent nouns by English-Greek bilinguals.

As the percentage of correct pronoun-agreement in plural number for both convergent and divergent nouns was 100%, ts <1, we conducted a paired sample t-test for correct pronoun-agreement only in singular number between convergent (*tree*) and divergent (*hair*) nouns. The results showed that the difference in correct responses between the two types of nouns was not significant; M = 100% vs. M = 99%, respectively [$t_1(11) = 1.92$; $t_2(19) = 1.83$].

5.7.4 Procedure, Scoring, Design and Data Analysis

These were identical to those of Experiment 6.

5.7.5 Results

Percentages of responses in the four scoring categories are shown in Table 31.

Single-Language Condition

		Language of Noun Phrase English (L1)			
Subj.-Noun Condition		**Scores in L1** Singular	Plural	Omiss.	Misc.
Conv.	Sg (tree)	98	0	1	1
	Pl (books)	0	99	1	0
Div.	Sg (hair)	88	6	2	4
	Pl (trousers)	3	93	1	3

CS Condition

Language of Noun-Phrase
Greek (L2)

Subj.-Noun Condition		**Scores in L1** Singular	Plural	Omiss.	Misc.
Conv.	Sg (δέντρο)	96	0	1	3
	Pl (βιβλία)	1	91	5	3
Div.	Sg (παντελόνι)	80	9	9	2
	Pl (μαλλιά)	67	18	10	5

Table 31. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Divergent = Div.; Singular = Sg; Plural = Pl).

Application of the scoring criteria for singular and plural pronouns, omissions and miscellaneous responses are reported in Table 32.

Source of variance		**F1** (1,11)	**F2** (1,76)
		F1 value	**F2 value**
Singular	Source-language	42.599***	17.691***
	Source-language number	2109.939***	646.819***
	Noun-type	38.301***	5.530**
	SL x SLN	116.933***	82.152***
	SL x NT	72.297***	16.184***
	SLN x NT	510.760***	88.907***
	SL x SLN x NT	165.910***	72.496***
Plural	Source-language	201.143***	37.719***
	Source-language number	5248.774***	645.939***
	Noun-type	108.795***	16.719***
	SL x SLN	153.320***	78.422***
	SL x NT	118.537***	31.298***
	SLN x NT	352.000***	71.115***
	SL x SLN x NT	215.600***	69.032***
Omissions	Source-language	6.592**	19.435***

	Source-language number	.793	.537
	Noun-type	11.560***	8.163**
	SL x SLN	1.669	.173
	SL x NT	7.301**	12.964***
	SLN x NT	.696	2.056
	SL x SLN x NT	.314	.154
Miscellaneous	Source-language	2.311	.056
	Source-language number	.000	1.593
	Noun-type	1.913	1.593
	SL x SLN	1.571	.507
	SL x NT	3.667	.056
	SLN x NT	.647	.279
	SL x SLN x NT	1.138	.056

Table 32. Results of 3-way ANOVAs with the proportions of singular and plural pronouns, omissions and miscellaneous responses (factors: source-language (SL), source-language number (SLN), and noun-type (NT)).

5.7.5.1 Results of Analysis on Convergent Nouns

Moreover, we conducted t-tests to compare pronoun agreement for singular and plural convergent subject nouns in single-language and CS conditions. That is, when the target language was always English (L1) but the source language could be either English (single-language condition) or Greek (CS condition; L2-L1 switch direction). In single-language completion, the difference in correct responses between singular (*tree*) and plural (*books*) nouns was not significant; M = 98 vs. M = 99 [$t_1(11) = .56$; $t_2(19) = .80$]. The results did not yield any significant difference between single-language and CS conditions for singular subject nouns; M = 98% vs. M = 96% [$t_1(11) = .90$; $t_2(19) = .44$]. That is, English bilinguals found equally easy to produce correct tag questions in single-language (e.g., *The tree in the garden got sold, didn't it?*) as in CS (e.g., Το δέντρο στον κήπο πουλήθηκε, *didn't it?*). For plural subject nouns the difference between correct single-language and CS conditions was significant in the analysis by participants whereby more responses were yielded in single-language than in CS (e.g., *The books in the library got stolen, didn't they?* vs. Τα βιβλία στη βιβλιοθήκη κλάπηκαν, *didn't they?*); M = 99% vs. M = 91% [$t_1(11) = 2.80$; $t_2(19) = 1.14$].

5.7.5.2 Results of Analysis on Divergent Nouns

In addition, we conducted t-tests for divergent subject nouns to examine the amount of influence of the non-target language in tag questions in the target language (single-language condition) as well as the patterns of pronoun-agreement in CS condition. The comparison of pronoun-agreement errors between divergent subject noun clauses and convergent subject noun clauses in single-language condition yielded a significant difference of number influence of the non-target language in the analysis by participants. Namely, 6% plural tag questions were produced following singular divergent subject noun clauses (e.g., **The hair of the girl got wet*, *didn't they?*), whereas no errors were yielded following singular convergent subject noun clauses [$t_1(11) = 3.92$; $t_2(19) = 1.79$]. Likewise, 3% singular tag questions were produced following plural divergent subject noun clauses (e.g., **The trousers of the boy got stained, didn't it?*), but no errors were yielded following plural convergent subject noun clauses [$t_1(11) = 2.35$; $t_2(19) = 2.18$]. Regarding the patterns of pronoun-agreement for divergent nouns in CS condition (L2-L1 switch direction), more singular than plural tag questions were yielded in the L1 both after L2 plural divergent subject noun clauses (*μαλλιά*; 'hair'), $M = 67\%$ vs. $M = 18\%$ [$t_1(11) = 8.82$; $t_2(19) = 6.09$], and after L2 singular divergent subject noun clauses (*παντελόνι*; 'trousers'); $M = 80\%$ vs. $M = 9\%$ [$t_1(11) = 10.26$; $t_2(19) = 2.44$].

5.8 Discussion

The findings from Experiment 7 on pronoun-agreement by English-Greek bilinguals replicated the findings from previous experiments (2 and 5) of the thesis on verb-agreement by speakers of the same L1. Namely, convergent subject nouns were not found to create any difficulty in pronoun-agreement either for single-language or CS conditions. Processing plural than singular number in the L2 (Greek) referent clause followed by an L1 tag-question in L2-L1 switch direction was somewhat more demanding. We attribute this finding to the rich inflectional system of the Greek language which adds a certain strain when it comes to plural form processing by speakers of morphologically less varied languages (e.g., English) (see also Franck et al., 2002).

The number of the noun in the non-target language (L2) interfered in pronoun-agreement in the target language in single-language (L1) tag-question production. This influence was somewhat stronger for an L1 singular noun (*hair*) whose translation equivalent was plural in the other language than for an L1 plural noun (*trousers*) whose translation equivalent was singular in the other language. The fact that production in the L1 was affected by the L2 shows that number divergence as a function of bilingual mode is strong enough to penetrate single-language speech planning, and provides further support for an account of parallel language activation (see also Kroll et al., 2006).

In L2-L1 direction, as was the case with verb-agreement, pronoun-agreement tended to be preferentially computed in singular number. That is, regardless of the number of the subject noun in the source-language, tag questions in the target-language tended to be produced in singular number. This effect was reliable after L2 singular subject nouns (*παντελόνι*) even though their translation counterpart in the L1 was plural (*trousers*). As previously, we might account this to the way the notional number of a noun can affect agreement during an on-line task where feature conflict across two languages is enhanced as a result of the bilingual setting of the experiment. Because the feature of singular notional number is shared across English and Greek for the type of nouns belonging to this category (see norms of Experiment 5), we argue that singular agreement production was employed as a language convergence mechanism whereby L2 lexical processing was mediated by L1 semantic content. In this respect, we might argue that pronoun-agreement in code-switched production for English-Greek bilinguals (Experiment 7) was considerably more sensitive to notional singularity compared to verb-agreement in the same condition (Experiment 5); $M = 80\%$ vs. $M = 64\%$ [$t_1(11) = 3.14$; $t_2(19) = 3.80$], thus providing support for the assumption of pronouns being more likely than verbs to agree with the number of the conceptual representation of the antecedent rather than its form (e.g., Bock et al., 1999). (Figure 13 shows the influence of notional number on verb- and pronoun-agreement for divergent nouns in L2-L1 switch direction).

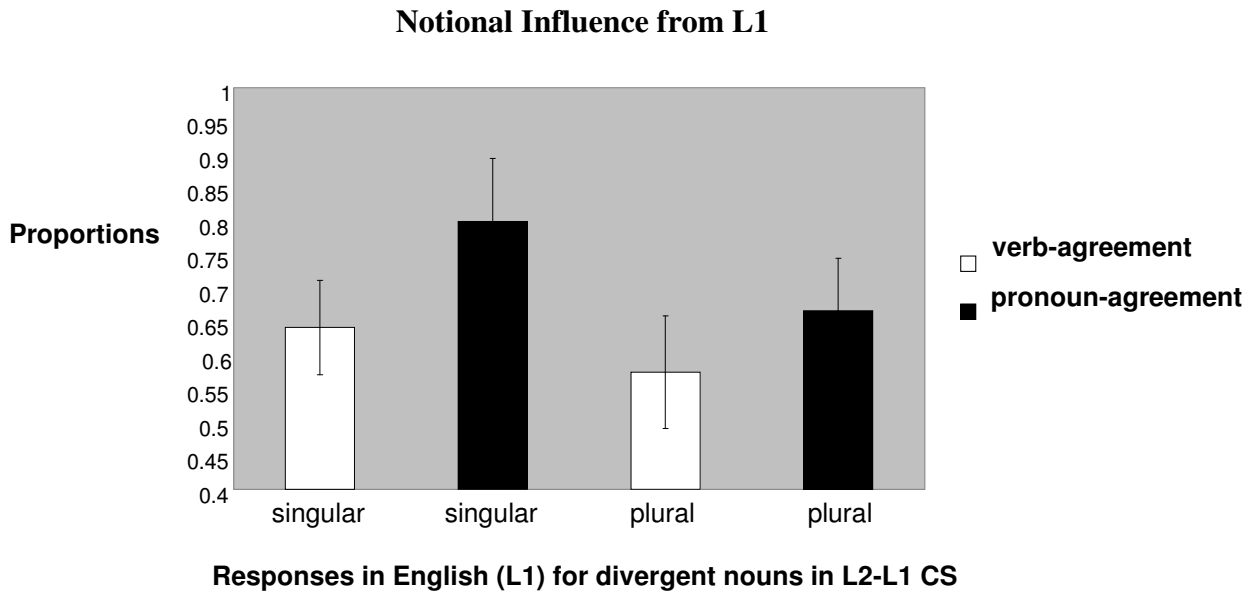

Figure 13. Proportions of verb- (Expt. 5) and pronoun-agreement (Expt. 7) in L2-L1 CS for divergent nouns.

EXPERIMENT 8: Semantic Relatedness in Mixed-Language Production by Greek-English Bilinguals

5.9 Rationale and Predictions

In the present experiment in which Greek-English bilinguals perform on tag-question production in single-language (L2) and L1-L2 CS as in Experiment 6, we seek to confirm whether the results we have obtained so far on pronoun-agreement are mainly due to the interaction of grammatical number divergence across the two languages and not due to any other semantic correlates (e.g., an item belonging to a category considered more or less singular/plural than another). Thus, we replaced and matched each divergent subject noun of the reference clause in each language with another semantically related convergent subject noun (e.g., *The hair of the girl got wet* by *The wig of the girl got wet*). We were interested in the responses of the related versus the unrelated (control) condition during tag-question formation. As it is assumed that in language tasks semantic interference occurs during lemma access rather than during conceptual processing (e.g., Schriefers et al., 1990; Roelofs, 1992), we predict that tag-

responses should be the same for semantically related and unrelated convergent nouns, because there would be no competing syntactic number features of the two languages to interfere in the process of pronoun-agreement.

5.10 Method

5.10.1 Participants

Twelve Greek-English fluent bilinguals who were native speakers of Greek and spoke English as a second language were paid to participate. They were all postgraduate students at the University of Edinburgh and had studied English through private tuition which involved grammar and written and oral practice for about 7 years (SD = .67) before moving to the UK. Their average age was 26 years (SD = 1.83). None of them had participated in the previous experiments, but the same procedure of recruitment was applied (see *Participants* specifications of Experiments 1, 3, 4, and 6). As we shall see below, Greek-English bilinguals' 100% accurate performance on the grammaticality judgement test demonstrated that participants possessed the relevant grammatical knowledge of agreement in the L2.

5.10.2 Materials

Materials were the same as those described in Experiment 6, except the replacement of divergent noun clauses in each experimental condition by semantically related convergent noun clauses. Semantically related convergent nouns were drawn from *Collins English Dictionary, Complete and Unabridged* (2003) as well as *Oxford Greek-English Learner's Dictionary* (1995), together with *Cassell Guide to Related Words* (1994), and *Use the Right Word: Modern Guide to Synonyms and Related Words* (1969). (See Appendix D for a complete list of the materials used in Experiment 8).

5.10.3 Post-Test

5.10.3.1 Grammaticality Judgement

This was the same as in Experiment 6, except the replacement of divergent noun sentences by semantically related convergent noun sentences (see Materials section). The percentage of correct

pronoun-agreement in both singular and plural number for both semantically related and unrelated convergent nouns was 100%, ts < 1. (For example sentences and results on the grammaticality judgment post-test see Table 33, and for materials Appendix F).

Semantically Related Convergent Nouns

	Singular	**Plural**
	A. *The wig of the girl got wet, didn't they?*	A. *The shirts of the boy got stained, didn't they?*
	B. *The wig of the girl got wet, didn't it?*	B. *The shirts of the boy got stained, didn't it?*
Scores (%)	**Singular**	**Plural**
Correct	100	100
Errors	0	0

Semantically Unrelated Convergent Nouns

	Singular	**Plural**
	A. *The tree in the garden got sold, didn't it?*	A. *The books in the library got stolen, didn't it?*
	B. *The tree in the garden got sold, didn't they?*	B.*The books in the library got stolen, didn't they?*
Scores (%)	**Singular**	**Plural**
Correct	100	100
Errors	0	0

Table 33. Example sentences from the grammaticality judgement task and results (%) for semantically related & unrelated convergent nouns by Greek-English bilinguals.

5.10.4 Procedure, Scoring, Design and Data Analysis

These were identical to those of Experiment 6.

5.10.5 Results

Percentages of responses in the four scoring categories are shown in Table 34.

Single-Language Condition

Subj.-Noun Condition		Language of Noun Phrase: English (L2) Scores in L2: Singular	Plural	Omiss.	Misc.
Conv.	Sg (tree)	93	0	3	4
Unrel.	Pl (books)	0	92	3	5
Conv.	Sg (wig)	93	0	1	6
Rel.	Pl (shirts)	0	95	2	3

CS Condition

Subj.-Noun Condition		Language of Noun-Phrase: Greek (L1) Scores in L2: Singular	Plural	Omiss.	Misc.
Conv.	Sg (δέντρο)	92	0	3	5
Unrel.	Pl (βιβλία)	0	90	3	7
Conv.	Sg (πουκάμισο; ‘shirt’)	94	0	2	4
Rel.	Pl (περούκες; ‘wigs’)	0	89	3	8

Table 34. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Unrelated = Unrel.; Related = Rel.).

Application of the scoring criteria for singular and plural pronouns, omissions and miscellaneous responses are reported in Table 35.

Source of variance		**F1** (1,11)	**F2** (1,76)
		F1 value	**F2 value**
Singular	Source-language	.071	.038
	Source-language number	4893.137***	7371.594***
	Noun-type	.102	.037
	SL x SLN	.071	.038
	SL x NT	.606	.345
	SLN x NT	.102	.037
	SL x SLN x NT	.606	.345
Plural	Source-language	4.231	5.556*
	Source-language number	8587.097***	3070.451***
	Noun-type	.208	.063
	SL x SLN	4.231	5.556*
	SL x NT	1.158	.889
	SLN x NT	.208	.063
	SL x SLN x NT	1.158	.889
Omissions	Source-language	1.471	.968
	Source-language number	1.063	.707
	Noun-type	.504	.707
	SL x SLN	.171	.242
	SL x NT	.206	.242
	SLN x NT	.171	.177
	SL x SLN x NT	.000	.000
Miscellaneous	Source-language	2.308	.818
	Source-language number	.157	.185
	Noun-type	.351	.021
	SL x SLN	3.378	2.649
	SL x NT	.000	.033
	SLN x NT	.484	.185
	SL x SLN x NT	2.146	1.602

Table 35. Results of 3-way ANOVAs with the proportions of singular and plural pronouns, omissions and miscellaneous responses (factors: source-language (SL), source-language number (SLN), and noun-type (NT)).

5.10.5.1 Results of Analysis on Unrelated Convergent Nouns

In single-language condition (tag-question production in L2), the results of correct tag questions following singular (*tree*) and plural (*books*) unrelated subject noun clauses did not yield a significant difference; M = 93% vs. M = 92% [$t_1(11) = .36$; $t_2(19) = .37$]. The results of correct tag questions in singular and plural number across tasks (single-language vs. CS) did not yield a significant difference either. That is, Greek-English bilinguals produced correct tag questions in singular number as often as in plural number regardless of whether the tag question was in the same language as the reference clause or not (e.g., *The tree in the garden got sold, didn't it?* vs. *Το δέντρο στον κήπο πουλήθηκε, didn't it?*); M = 93% vs. M = 92% [$t_1(11) = .43$; $t_2(19) = .25$], and (*The books in the library got stolen, didn't they?* vs. *Τα βιβλία στη βιβλιοθήκη κλάπηκαν, didn't they?*); M = 92% vs. M = 90% [$t_1(11) = 1.00$; $t_2(19) = 1.37$].

5.10.5.2 Results of Analysis on Related Convergent Nouns

Following the same analysis we conducted for divergent nouns in Experiments 6 and 7, we sought to examine any errors yielded in single-language with related convergent noun sentences vs. unrelated convergent noun sentences in singular (*wig* vs. *tree*) and plural number (*shirts* vs. *books*). As the standard error of the difference was 0, we could not compute the t-tests. In CS, the difference between singular and plural tag-question responses following singular and plural related convergent nouns was significant. That is, 89% plural tag questions vs. 0% singular tag questions were produced following plural related convergent nouns (*περούκες*; 'wigs') [$t_1(11) = 38.95$; $t_2(19) = 43.04$], and 94% singular tag questions vs. 0% plural tag questions were produced following singular related convergent nouns (*πουκάμισο*; 'shirt') [$t_1(11) = 48.79$; $t_2(19) = 35.67$].

5.11 Discussion

The findings from Experiment 8 confirmed our hypothesis that pronoun-agreement errors and patterns of responses that Greek-English bilinguals yielded in Experiment 6 in the corresponding single-language and CS conditions respectively were due to grammatical number divergence across languages that was accentuated by the bilingual mode setting, and not solely due to any semantic correlates. To

illustrate this with an example from the present experiment, a singular convergent noun reference clause such as *The wig of the girl got wet* (which was semantically related to a singular divergent noun reference clause such as *The hair of the girl got wet*) did not induce any plural pronoun-agreement in its produced tag question despite sharing many features with the latter. Thus, we argue that parallel language activation of morphological conflicting features across languages (in this case *number divergence*) is a strong enough factor (at least for Greek-English bilinguals) to interfere in speech planning, even when only one language is intended for articulation. This influence was even more enhanced when Greek-English bilinguals were required to produce utterances by alternating between their languages. Therefore, based on the results of the present experiment we may conclude that language interaction has negligible effects on bilingual speech production when there is no clash of syntactic features across the two interacting languages.

We need to note that although participants' knowledge of pronoun-agreement in tag questions was excellent, as revealed by the grammaticality judgement task, their on-line performance was not as good. Despite not making any agreement errors, Greek-English bilinguals yielded a number of miscellaneous responses (especially in plural CS condition) whereby they tended to produce a tag question in the same language as the source language (e.g., *Τα βιβλία είναι παλιά, έτσι δεν είναι;* 'The books are old, isn't that so?') instead of producing the tag question in the target language. As we argued in Experiment 6, the reason for this may be that tag questions in code-switched on-line production may be more demanding in comparison to subject-verb sentence completion in the corresponding condition.

EXPERIMENT 9: Semantic Relatedness in Mixed-Language Production by English-Greek Bilinguals

5.12 Rational and Predictions

In Experiment 9 with English-Greek bilinguals we replicate Experiment 8 where we manipulate the semantic relatedness between convergent and divergent subject nouns in reference clauses for which tag questions in single-language and CS are required. We were interested in the responses to semantically related vs. unrelated convergent nouns.

5.13 Method

5.13.1 Participants

Twelve English-Greek fluent bilinguals who were native speakers of English and spoke Greek as a second language were paid to participate. At the time of the testing, they all lived in Athens and had studied Greek through private tuition which involved grammar, written and oral practice for a mean of 4 years (SD = .56) before moving to Greece. Their average age was 46 years (SD = 1.95). None of them had participated in the previous experiments, but the same recruitment procedure was applied as in Experiments 2, 5, and 7 (see corresponding sections).

5.13.2 Materials

These were identical to those of Experiment 8.

5.13.3 Post-Test

5.13.3.1 Grammaticality Judgement

This was the same as in Experiment 8, except that the grammaticality forced-choice task tested bilinguals' knowledge of pronoun-agreement in tag questions in their L1. The percentage of correct pronoun-agreement in both singular and plural number for both semantically related and unrelated convergent nouns was 100%, ts < 1. (See Table 36).

Semantically Related Convergent Nouns

	Singular	**Plural**
	A. *The wig of the girl got wet, didn't they?*	A. *The shirts of the boy got stained, didn't they?*
	B. *The wig of the girl got wet, didn't it?*	B. *The shirts of the boy got stained, didn't it?*
Scores (%)	**Singular**	**Plural**
Correct	100	100
Errors	0	0

Semantically Unrelated Convergent Nouns

Singular	**Plural**
A. *The tree in the garden got sold, didn't it?*	A. *The books in the library got stolen, didn't it?*
B. *The tree in the garden got sold, didn't they?*	B.*The books in the library got stolen, didn't they?*

Scores (%)	**Singular**	**Plural**
Correct	100	100
Errors	0	0

Table 36. Example sentences from the grammaticality judgement task and results (%) for semantically related & unrelated convergent nouns by English-Greek bilinguals.

5.13.4 Procedure, Scoring, Design and Data Analysis

These were identical to those of Experiment 8.

5.13.5 Results

Percentages of responses in the four scoring categories are shown in Table 37.

Single-Language Condition

Language of Noun Phrase
English (L1)

Subj.-Noun Condition		**Scores in L1** Singular	Plural	Omiss.	Misc.
Conv. Unrel.	Sg (tree)	98	0	2	0
	Pl (books)	0	97	0	3
Conv. Rel.	Sg (wig)	98	0	2	0
	Pl (shirts)	0	96	2	2

CS Condition

Subj.-Noun Condition		Language of Noun-Phrase: Greek (L2) Scores inL1 Singular	Plural	Omiss.	Misc.
Conv. Unrel.	Sg (δέντρο)	92	0	1	7
	Pl (βιβλία)	0	88	4	8
Conv. Rel.	Sg (πουκάμισο; 'shirt')	94	0	1	5
	Pl (περούκες; 'wigs')	0	91	2	7

Table 37. Percentages of responses in four scoring categories by subject noun condition. (Convergent = Conv.; Unrelated = Unrel.; Related = Rel.; Singular = Sg; Plural = Pl).

Application of the scoring criteria for singular and plural pronouns, omissions and miscellaneous responses are reported in Table 38.

Source of variance		**F1** (1,11)	**F2** (1,76)
		F1 value	**F2 value**
Singular	Source-language	16.036***	11.122***
	Source-language number	9152.745***	7746.635***
	Noun-type	1.000	.149
	SL x SLN	16.036***	11.122***
	SL x NT	1.000	.309
	SLN x NT	1.000	.149
	SL x SLN x NT	1.000	.309
Plural	Source-language	20.510***	12.100***
	Source-language number	16628.053***	5657.982***
	Noun-type	1.941	.459
	SL x SLN	20.510***	15.313***
	SL x NT	1.536	1.701
	SLN x NT	1.941	.115
	SL x SLN x NT	1.536	.756
Omissions	Source-language	.256	.626

	Source-language number	.673	.474
	Noun-type	2.099	1.316
	SL x SLN	3.477	3.410
	SL x NT	1.536	1.740
	SLN x NT	.044	.053
	SL x SLN x NT	3.313	1.740
Miscellaneous	Source-language	27.390***	25.871***
	Source-language number	4.068	2.486
	Noun-type	.186	.031
	SL x SLN	.186	.041
	SL x NT	.340	.373
	SLN x NT	.054	.031
	SL x SLN x NT	1.941	.373

Table 38. Results of 3-way ANOVAs with the proportions of singular and plural pronouns, omissions and miscellaneous responses (factors: source-language (SL), source-language number (SLN), and noun-type (NT).

5.13.5.1 Results of Analysis on Unrelated Convergent Nouns

In single-language condition (tag-question production in L1), the results of correct tag questions following singular (*tree*) and plural (*books*) unrelated subject noun clauses did not yield a significant difference; M = 98% vs. M = 97% [$t_1(11) = .43$; $t_2(19) = .37$]. The results of correct tag questions in singular and plural number across tasks (single-language vs.CS) yielded a significant difference. That is, English-Greek bilinguals produced more correct tag questions in singular and plural number when they produced them in the same language (their L1) than when they code-switched (L2-L1): (*tree* vs. *δέντρο*); M = 98% vs. M = 92% [$t_1(11) = 3.02$; $t_2(19) = 2.33$], and (*books* vs. *βιβλία*); M = 97% vs. M = 88% [$t_1(11) = 4.01$; $t_2(19) = 2.98$].

5.10.5.2 Results of Analysis on Related Convergent Nouns

As in the preceding experiment with Greek-English bilinguals (Expt. 8), the standard error of the difference between errors yielded in single-language with related convergent noun sentences vs. unrelated convergent noun sentences in singular (*wig* vs. *tree*) and plural number (*shirts* vs. *books*) was 0. Therefore, we could not compute the t-tests. In Cs, the difference between singular and plural tag-

question responses following singular and plural related convergent nouns was significant. That is, 91% plural tag questions vs. 0% singular tag questions were produced following plural related convergent nouns (*περούκες*; 'wigs') [$t_1(11) = 61.11$; $t_2(19) = 36.16$], and 94% singular tag questions vs. 0% plural tag questions were produced following singular related convergent nouns (*πουκάμισο*; 'shirt') [$t_1(11) = 63.35$; $t_2(19) = 47.75$].

5.14 Discussion

In Experiment 9 with English-Greek bilinguals we replicated the results of Experiment 8 with Greek-English bilinguals whereby the manipulation of semantic relatedness was not found to affect pronoun-agreement error rates. That is, convergent subject nouns that were semantically related to the divergent nouns which were used in the previous verb- and pronoun-agreement experiments of the thesis did not induce any more agreement errors than unrelated (control) convergent nouns. Therefore, we argue that evidence of influence of the non-target language on production in the target language that we obtained from verb- and pronoun-agreement experiments in this study can be attributed mainly to the conflicting syntactic properties of divergent nouns across the two languages that we examined, as well as the bilingual mode which enhanced any such influence by co-activating those conflicting features. However, in the preceding experiments, we also found evidence that notional number has also had a share in agreement processing. This was assumed based on the norm ratings that we collected from both groups of bilinguals (particularly, from English-Greek bilinguals) as well as English bilinguals' performance in L2-L1 CS with divergent nouns in verb-and pronoun-agreement experiments. This latter finding is worth further examining in future bilingual studies.

5.15 Chapter Summary

In Chapter 5, we investigated the effects of the bilingual mode and number divergence on pronoun-agreement. In Experiments 6 and 7, we manipulated the number of nominal subjects (divergent vs. convergent) in reference clauses for which a tag question should be produced either in the same language as the clause (single-language condition) or in the other language (CS condition). The focus of our interest was in responses in English, as tag questions in Greek are unspecified for number. In

Experiments 8 and 9 also with Greek-English and English-Greek bilinguals respectively, we replicated the previous two experiments with tag-pronouns, this time by manipulating the semantic category of nominal convergent subjects (semantically related to divergent nouns vs. unrelated).

The results of pronoun-experiments with divergent nouns (Experiments 6 and 7) replicated the results of verb-experiments of the thesis in both groups of bilinguals. Namely, convergent nominal subjects whose grammatical/notional number was the same across the two languages did not pose any difficulty in pronoun-agreement implementation either when tag questions where computed in single-language (English) or in code-switching (Greek-English). Divergent nominal subjects yielded similar patterns of number influence of the non-target language in production on the target language. More particularly, pronoun-agreement by Greek-English bilinguals was found to be significantly sensitive following L2 singular divergent subject nouns (*hair*) whose translation equivalent in the L1 was plural (*μαλλιά*). English-Greek bilinguals also provided evidence of number influence of the non-target language on the target language, and it is worth noting that for them this influence originated from their L2, as it was also witnessed in Experiment 5 on verb-agreement.

Pronoun-agreement processing in Greek-English CS yielded the same patterns of responses as verb-agreement processing in the corresponding condition. That is, Greek-English bilinguals overwhelmingly produced a pronoun in the L2 that agreed in number with the L1 nominal subject. English-Greek bilinguals, on the other hand, tended to produce singular pronoun-agreement. It is notable that this was particularly enhanced following L2 singular divergent subject nouns (*παντελόνι*) which were notionally singular but morphologically plural in the L1 (*trousers*). Comparing the results of this condition in pronoun-agreement (Experiment 7) to those yielded in the corresponding condition in verb-agreement (Experiment 5), we obtained a significant difference of semantic influence between the former and the latter, thus providing additional support to the assumption that more pronouns than verbs are sensitive to the notional influence of their referents (e.g., Bock et al., 1999).

The results of the pronoun-experiments with semantically related vs. unrelated convergent nouns (Experiments 8 and 9) confirmed our hypothesis that pronoun-agreement errors (and by extension verb-agreement errors) that were yielded in the experiments with divergent subject-nouns were due to

grammatical number divergence across languages that was enhanced by the bilingual mode of the experimental setting, and not due to mere semantic influence of their category membership. Therefore we conclude that language interaction effects are higly correlated with syntactic feature clash across languages.

CHAPTER 6

Conclusions

6.0 Chapter Overview

This thesis has presented the results of 9 experiments that have investigated language interaction effects on bilingual sentence production in verb- and pronoun-agreement. This chapter describes the major findings of the experiments and discusses their implications for bilingual language processing as well as directions for future research. The thesis contains three experimental chapters, and as such this chapter is broken into three sections, each of which discusses findings and issues from each of the experimental chapters. Finally, we interpret our results in terms of a model of bilingual sentence production.

6.1 Summary of the Findings

6.1.1 Chapter 3: Sentence Production in the Monolingual Mode: Verb-Agreement

Experiments 1 and 2 with Greek-English and English-Greek bilinguals respectively investigated the impact of the non-target language (L1) when speakers produced utterances in the target language (L2) during subject-verb agreement construction with nominal subjects whose number either differed across the two languages (divergent nouns) or not (convergent nouns). Greek-English bilinguals' results yielded a small, yet significant effect of L1 influence on L2 verb-agreement when the subject noun was singular but its translation equivalent in bilinguals' native language was plural (morphologically and notionally). We argue that the plural divergent number properties of the translation in the non-target language were strong enough to "attract" verb-agreement like plural local nouns have been reported to do in complex NPs on S-V agreement in monolingual literature (e.g., Eberhard, 1997). This not only provides evidence for parallel language activation in single-language discourse (e.g., Costa et al., 1999), but also support for language competition and interference (e.g., Colomé, 2001), extending the findings from bilingual research at word level (e.g., Hermans et al., 1998) to sentential level. Moreover, evidence of L1 influence on L2 production when the former is not the response language indicates that, although proficiency in the L2 and the nature of the experimental task may be responsible for the extent of each language

participation (Jared & Kroll, 2001), L1 activation is generally set as "default" in bilingual processing (see also Kroll et al., 2006).

English-Greek bilinguals, however, showed minimal (i.e., non-significant) influence of their L1 on the L2 when they produced single-language utterances in the monolingual mode. This is consistent with an account in which English-Greek bilinguals may rely upon different linguistic and extra-linguistic information than Greek-English bilinguals when they complete sentences in their L2 because of the properties of the English language (e.g., less varied inflectional system) (see also Vigliocco et al., 1995, 1996b). Additionally, the following reasoning could apply to the above-mentioned finding: in order for a bilingual to produce successfully meaningful utterances in the target language, a conscious decision to speak only in that language and not in the other is needed. This choice needs to be supported by the use of some kind of control over the non-target language (Green, 1986). Thus, we argue that English-Greek bilinguals might be able to exert better control over the non-target language and therefore be less influenced by the L1 than Greek-English bilinguals. In other words, the English language properties we mentioned previously may make the task of language control easier for English-Greek bilinguals in comparison to Greek-English bilinguals whose language properties (e.g., rich inflectional system) appear to increase the possibilities of interference from the L1.

The fact that both groups of bilinguals performed satisfactorily while producing utterances entirely in their L2 implies the operation of an attentional control mechanism that allows bilinguals to keep apart each of their languages when speaking in only one of them. In the literature review (Chapter 2) we discussed certain assumptions that have been put forward to explain language selection and control in bilingual speech, such as inhibition of the non-intended language (e.g., Green 1998; Rodriguez-Fornells, De Diego Balaguer, & Münte, 2006), higher activation of the intended language (e.g., Roelofs, 1998), or high proficiency in both languages which favours language specificity (Costa et al., 2006), while most researchers agree that specification of the intended language is contained in the preverbal message (e.g., La Heij, 2005). Although we did not address this issue directly in our experiments, the results we obtained from both bilingual groups on verb-agreement in the monolingual mode could be interpreted in the following way. We may argue that a residual trace of recurrent activation of the same language facilitates the retrieval of words belonging to that language since these words have a lower activation

threshold level than words from the non-target language, thus reducing the likelihood of language interference (see also Poulisse & Bongaerts, 1994, for a similar idea). This reasoning can accommodate both an *inhibition* and a *language-specific* account. In the first case, inhibitory effects become stronger through persistent repetition of single-language production, thus easing access to the target language. In the second case, no change in the language set across trials is expected to enhance processing in the language specified for production from the initial stage of preverbal message.

6.1.2 Chapter 4: Sentence Production in the Bilingual Mode: Verb-Agreement

Chapter 4 presented 3 experiments in which Greek-English and English-Greek bilinguals completed sentences with divergent and convergent nominal subjects in both their languages, performing in single-language and code-switching conditions in the same session. We sought to investigate whether the bilingual mode would enhance language interference that was yielded previously in the monolingual mode in single-language completion by Greek-English bilinguals, and whether it could induce interference effects in English-Greek bilinguals' speech that were not yielded in the monolingual mode. In addition, we were interested in the patterns of verb-agreement processing in both L1-L2 and L2-L1 switch directions.

The results of Greek-English bilinguals replicated the finding of parallel language activation and influence of the L1 on the L2 during single-language completion which was particularly enhanced in this bilingual mode setting where code-switching was also involved (see also Price, Green, & Von Studnitz, 1999). Surprisingly, English-Greek bilinguals were not only influenced by the bilingual mode manipulation in single-language completion in the L2, but also in single-language completion in their L1 (see also Wijnendaele & Brysbaert, 2002, for L2 influence on the L1, and Pavlenko & Jarvis, 2002, for bidirectional influence). We argue that the nature of an on-line language task, which demands co-activation and equal participation of the two language systems, may create a considerable cognitive load, and therefore more possibilities of occurrence of errors (e.g., Fayol et al., 1994), especially when the competition is between two language systems of rich and relatively poor morphology.

The findings from CS yielded very interesting patterns of responses providing support to the view that bilinguals process linguistic elements by integrating language information from both their languages (Hartsuiker et al., 2004; Kroll & Dussias, 2004). The results of convergent nouns confirmed our hypothesis that when there is congruence between the number features of the two languages in code-switched speech, bilingual speakers continue to obey the syntactic restrictions imposed by the initial fragment of the sentence in producing the completion, but deactivate the source language and activate the target language instead. In this way, S-V agreement is realized following the same rules as in monolingual speech. However, when there is incongruence between the number features of the two languages in code-switched production there are three possibilities of language behaviour: a) the verb that is produced in the target language agrees in number with the subject noun in the source language, b) the verb that is produced in the target language agrees in number with the noun in the target language, and c) compromise strategies may emerge. We obtained evidence for each one of these possibilities which were modulated by language dominance, switch direction, and feature salience across the two languages.

An important finding in this thesis is evidence for language dominance in CS, especially in L1-L2 switch direction. Monolingual studies on S-V agreement with complex NPs have provided evidence that the morphology of the subject noun does have an effect on the probability of correct/wrong agreement (Bock & Miller, 1991; Bock & Eberhard, 1993), and that the subject noun's semantics may also affect verb implementation, sometimes to a high (Vigliocco et al., 1995) and sometimes to a low extent (Bock et al., 1999; Bock et al., 2001). In the present bilingual study, a common finding in more than half of the responses for both Greek-English and English-Greek bilinguals in CS was that verb-agreement was implemented according to the grammar rules of the source language (L1). In other words, there was a bias towards L1 feature copying onto the verb due to L1 triggering the verb-computation process. Thus, our research additionally shows that the influence of the subject noun on verb-agreement may also increase as a factor of *language dominance*. This provides further support for the claim that the two languages of a bilingual do not contribute equally in code-switching (Myers-Scotton, 2002).

Further evidence for language integration in bilinguals comes from our results in L2-L1 direction. Similarly to the responses in single-language completion following singular divergent nouns (*hair*) in

which Greek-English bilinguals yielded a significant number of plural verb-agreement, they also produced plural-inflected verbs in CS following the same L2 singular divergent nouns. We argue in support of a markedness account as these nouns' divergence appears to be "double-marked" (morphologically and notionally) across the two languages. Or else, plural feature salience in the L1 for that category of nouns encouraged plural-verb agreement. Greek-English bilinguals' sensitivity to plural number is also evident in their responses following L2 plural divergent nouns (*trousers*). Despite the exact translation of these nouns being singular in Greek (*παντελόνι*), there is also the option of a plural-marked noun which can denote many pairs of trousers unlike English. Our findings show that when the Greeks were presented with the English plural noun in L2-L1 direction, they interpreted it as plural and produced plural verb-agreement, whereas when they were presented with the Greek singular noun in L1-L2 direction, they opted for the singular translation and yielded singular verb-agreement. We assume that Greek-English bilinguals in order to provide a meaningful completion to the presented NPs had first to decode the meaning of the latter. Thus, phonological effects during comprehension in combination with time-limited response requirements led them to rely considerably on the cue of the plural marker of the English word and enhance the activation of the plural option in their L1, thus resulting in plural verb-agreement (see Haskell & MacDonald, 2003, for a discussion of morphophonological effects on conceptual representation).

But how did English-Greek bilinguals behave in L2-L1 CS for singular and plural divergent nouns? Overall, there was a tendency towards singular verb-agreement. Thus, following both L2 plural (*μαλλιά*; 'hair') and singular (*παντελόνι*; 'trousers') divergent nouns, the verb that was produced in the L1 was singular in more than half of the responses. To interpret this finding we cannot exclude an account that would support that during cognitively demanding tasks bilinguals may not be always able to locate a suitable lemma in the target language in time (Wheeldon & Monsell, 1994) and produce, in this case, singular by default. Moreover, bare forms (Ø form) and lack of plural marking have been observed in a number of CS corpora, and it has been suggested that this may emerge as a response to processing difficulties (Owens, 2005). Therefore, the syntactic properties and pragmatic representation of this category of nouns might not always be retrieved in time. Or it could be that more demanding subject nouns like these ones were overridden by other (singular) subject nouns that required less effort to

integrate in a speech production act due to performance limitations, thus leading to singular agreement which would be the easiest option.

Furthermore, many linguists recognize that language contact may lead to structures that display evidence of "interference" or so-called transfer (Myers-Scotton & Jake, 2001), and that lack of sufficient congruence between the two language systems at any level of representation may lead to "compromise" structures in code-switched speech (Myers-Scotton, 2002). We assume that English-Greek bilinguals' singular responses in CS following L2 singular divergent nouns (*παντελόνι*; 'trousers') might have worked as a compromise between the incompatible features of the two languages, especially in this elicited on-line task where the size of feature conflict was even more enhanced through language alternation and time-pressure. The notion of *convergence* has also found support from other studies on CS (Muysken, 2002; Montrul, 2004) and Toribio (2004) has described it as "*The searching for parallels between the two languages to reduce the complexity and cognitive cost of processing two simultaneously active language systems*". Thus, we interpret the above finding from English-Greek bilinguals as evidence for *agreement convergence* resulting from the singular notional number that was common in the two languages. Therefore we argue that in CS, when there is feature conflict across the two languages, the production system tends to resolve agreement based on the most salient component from the contact of bilinguals' languages which creates the lowest degree of impact on sentence processing.

Interestingly, the finding of singular agreement in Enlgish-Greek bilinguals' responses contradicts Woolford's (1983) claim that bilinguals use both their grammars and syntactic structures building up sentences that respect each language's linguistic constraints if considered in isolation. This entails that if bilinguals switch from one language to another at a point in a sentence where the structure is shared between the two languages, they will only have to fill that part of the sentence with lexical features from the appropriate language. Applying this reasoning to English-Greek bilinguals' performance in our experiments, since the switch site was always after an NP, that is, a common syntactic structure between English and Greek, participants would simply have to fill that segment of the sentence with linguistic elements from the target language. However, as we explained in the preceding paragraphs, this was not how English-Greek bilinguals behaved following L2 singular divergent nouns where they did NOT produce a verb that agreed in form with the translation equivalent in the target language if considered in

isolation. Instead, the English verb was produced in singular agreeing with the notional number of that category of nouns (e.g., Το παντελόνι *is black*; 'The trousers is black') (see also Bock et al., 2001). This finding provides additional evidence that CS is not an act of speech of juxtaposed languages and that it is sensitive to linguistic as well as extra-linguistic factors.

6.1.2.1 Language and Thought

Our findings are also relevant to the issue of whether language can affect thought (see Hunt & Agnoli, 1991, for a review), particularly, whether a difference in grammatical categories across languages may reflect different conceptual organization across bilinguals (Bowerman & Levinson, 2001; see also Green, Crinion, & Price, 2006, for a review on functional and structural brain changes as a result of more than one language acquisition). It is assumed that language acquisition is possible because of the existence of "conceptual primitives" (prelinguistic notions) which are common to all humans (Chomsky, 1984). Lucy and Gaskins (2001) argue that if reference to some objects is similar between two languages, no major cognitive differences are expected (see also Papafragou, 2005, for a review on individuation and the count/mass distinction). However, a concept may be common to both languages, yet some aspects of that notion may be specific to one language (e.g., De Groot, 1992a; Silverberg & Samuel, 2004), and thus affect language processing (see Costa, Alario, & Sebastian-Gallés, 2007, for a review on cross-linguistic research on language production). For instance, Bock et al. (2006) argue that despite both British and American collective agreement reflecting number semantics, the latter appears to be different from number semantics of British English because of the way speakers resolve ambiguities in collective and distributive senses. The development of this or other kinds of agreement differentiation might even start from an early age of language acquisition where children learn to use and rely on specific properties of linguistic elements.

In line with the above assumptions, we argue that bilinguals may process the same language information focusing on different cues, or that even if the cues are the same across languages, their strength may differ, thus resulting in differential speech processing. This claim is supported by the ratings we collected on the notional number of divergent nouns by the two groups of bilinguals that we tested in our experiments. (A comparison of the norm ratings between Greek-English and English-Greek

bilinguals on divergent nouns is shown in Figure 14). We should note that reference to "notional" number translates into the way a noun was perceived by the speakers when it was seen in English and when it was seen in Greek. We do not imply that the difference in norm ratings between Greek and English means that bilinguals think in an entirely different way when they speak in one language than when they speak in the other; rather a mode of thought is favored over another (Lucy, 1992).

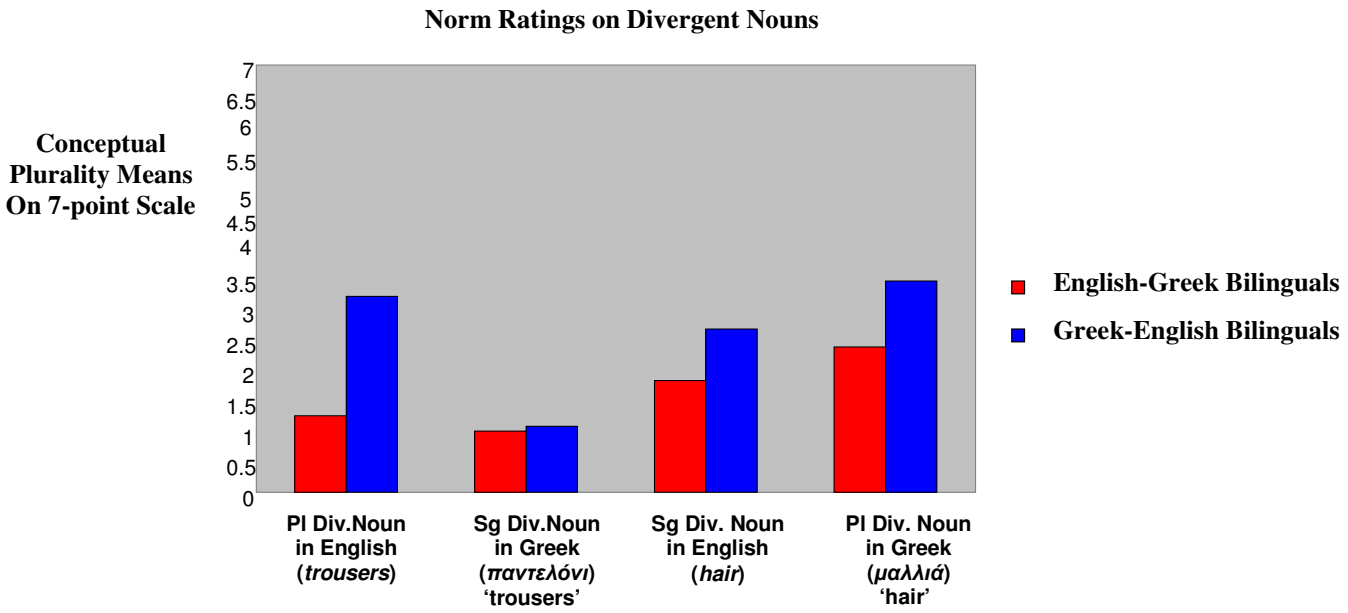

Figure 14. Mean ratings from English-Greek and Greek-English bilinguals on singular and plural divergent nouns when seen in English and when seen in Greek.

6.1.3 Chapter 5: Sentence Production in the Bilingual Mode: Pronoun-Agreeement

Chapter 5 presented four experiments that investigated the effects of the bilingual mode and number divergence on pronoun-implementation. Moreover, we sought to examine whether pronoun-agreement is subject to the same effects as verb-agreement, and whether pronouns are processed in the same way by speakers of a different L1. Experiments 6 and 7 asked Greek-English and English-Greek bilinguals to produce tag questions for divergent and convergent reference clauses in single-language and code-switched utterances. As we were interested in English tags (since Greek tags are unspecified for number), single-language completion for Greek-English bilinguals would be performed in their L2 and CS

completion in L1-L2 switch direction. On the other hand, single-language completion for English-Greek bilinguals would be performed in their L1 and CS completion in L2-L1 switch direction. The results yielded similar effects to those yielded in verb-agreement experiments by each group of speakers in the corresponding conditions. Namely, Greek-English bilinguals in single-language completion showed effects of influence of the plural translation of an L2 singular referent (e.g., **The hair of the girl got wet, didn't they?*), and in L1-L2 CS effects of L1 dominance in pronoun-implementation (e.g., Τα μαλλιά του κοριτσιού βράχηκαν, *didn't they?*; 'The hair of the girl got wet, didn't they?'). English-Greek bilinguals in single-language completion showed small yet reliable effects of influence of their L2, and in L2-L1 CS a tendency towards singular pronoun-agreement especially following L2 singular divergent nouns (e.g., *Το παντελόνι του αγοριού λεκιάστηκε, didn't it?*; 'The trousers of the boy got stained, didn't it?').

Experiments 8 and 9 with Greek-English and English-Greek bilinguals respectively manipulated the semantic relatedness of the subject nouns in the reference clause to confirm whether the effects that we obtained in the previous verb- and pronoun-experiments with divergent nouns were mainly due to morphological number divergence across the two languages and not due to the semantics of a specific category membership (e.g., an item belonging to a category considered more or less singular/plural than another). The results of both bilingual groups corroborated our hypothesis as they showed no differences between single-language and CS conditions. This is in line with an account that supports that bilinguals have a single semantic network (e.g., Macnamara, 1967; Kroll, 1993), and that in respect with our previous findings, it was syntactic number divergence (enhanced by the bilingual mode) and not any kind of semantic categorization that led speakers to yield the responses they did in the preceding experiments. Therefore, our findings allow us to conclude that although speakers of different languages may deploy the same sources differently (e.g., Vigliocco et al., 1995), they can also respond similarly when these sources have most of their features in common.

6.1.4 Our Findings in Light of Code-Switching Theories

Our approach to code-switching was rather exploratory in this thesis as this study is the first to investigate language interaction effects in number agreement both in the monolingual and the bilingual modes in which code-switching is also involved. Therefore, we employed CS more as a tool to enhance the bilingual mode rather than as a guideline to make predictions for bilingual speech behaviour. In this section, however, we attempt to interpret our findings in light of current CS theories and assumptions.

With respect to the two most-often cited models in the CS literature, our experimental manipulations can be better accommodated by the Matrix Language Frame model (MLF) proposed by Myers-Scotton (1993) than the Minimalist model of MacSwan (2004). This is so because the former allows for the use of incongruent features in mixed-language production and makes predictions about such utterances, whereas the latter does not. For instance, Myers-Scotton (2005) argues there are cases when a lexical item from one language may follow a frame-structure that does not exist in its language of origin. The latter pattern may also occur in cases where there is not an exact match between a concept from one language and its counterpart in the other, or because such a concept does not exist in one of the two languages. This entails that the non-dominant language or *Embedded Language* (EL) will have to follow the morphological realization and predicate-argument structure imposed by the dominant language or *Matrix Language* (ML). (We explain this distinction below).

The basic assumption of MLF lies in the claim that during code-switched speech one language sets the morphosyntactic framework (*Matrix Language*; ML) and the other inserts its linguistic elements (*Embedded Language*; EL). In the literature review (Chapter 2), we presented several contrasting views that have been expressed as to what characteristics determine whether a language may play the role of ML or of EL. Based on the data from our participants, we adopt a sociolinguistic approach whereby we assume that the language that speakers are more proficient in is the ML that would host the EL (e.g., Myers-Scotton, 1995). (Parenthetically, and before we discuss our findings from each switch direction, we need to note first that according to MLF terminology, the code-switching formations that were yielded in our experiments were *islands*. That is, each segment in a switch was composed of elements entirely belonging to the language spoken before and after the switch, respectively. In other words, in all

the responses that we obtained there was not a single instance of mixed morphemes from the two languages). If we assume that one language is more structurally dominant thus providing the frame for agreement, the question that follows is which features are accessed in the case of number agreement. Myers-Scotton (2002) argues that ML often inhibits the full formation of an EL island if such a formation does not exist in ML, and this is exactly what we found as we discuss below.

The results of both bilingual groups in L1-L2 switch direction showed a preference for the verb acquiring the number specification of the L1 subject noun, providing support for the claim that the L1 was the ML that provided the framework the L2 verb was inserted in. In L2-L1 switch direction, Greek-English and English-Greek bilinguals also provided evidence that the L1 was the ML which provided the syntactic framework. The Greeks, as we discussed previously, following L2 plural divergent nouns (e.g., *trousers*) opted for the plural translation and inflected the verb in the L1 appropriately. Such kinds of language manifestation provide indirect evidence of the linguistic ability of bilinguals to "manipulate" their languages in such a way so as not to disrupt the flow of discourse. In other words, bilinguals select the most parsimonious grammar that serves both languages (Toribio, 2004). English-Greek bilinguals displayed a similar behaviour, yet leading to different results. That is, following L2 singular divergent nouns (e.g., *παντελόνι*; 'trousers') they made the verb in the L1 agree with the singular notion of the subject noun that was common in the two languages.

Occurrence of bare forms or morphological adaptations often emerge as a compromise strategy when there is a clash between the morphosyntactic requirements of the two languages (e.g., when a lexical category is present in one language but not in the other, or when there is a pragmatic mismatch between the lexical items of two languages) (Myers-Scotton & Jake, 1995). That is, when a speaker uses an EL content morpheme, its corresponding EL lemma is activated. If there is a counterpart of the EL lemma in ML it will be checked for congruence against the former. If there is not, the EL lemma will be matched with ML material that appears to be as close to the EL lemma as possible. When there is "sufficient congruence", EL material can appear within a ML frame following the latter's specifications. When there is incongruence, compromise strategies emerge. We might also assume that some sort of competition between the features of the Embedded Language and the Matrix Language, as a result of incomplete mapping between forms and concepts across the two languages, could prevent the ML from providing all

its expected elements to the formation of the corresponding language segment. Thus, in the results by English-Greek bilinguals the verb or predicate adjective in the L1 did not agree with the plural number of the noun in the L1 (e.g., Το παντελόνι *is short*; 'The trousers is short') (see also Myers-Scotton, 2002, for a similar account).

How might S-V agreement in code-switched speech be realized in our experiments? The findings from responses following L2 singular subject nouns in L2-L1 switch direction can be interpreted under the scope of 4-M model, proposed by Myers-Scotton and Jake (2000; 2001) to reinforce the existing MLF model. In this model, the authors make an attempt to describe the underlying processes that lead to code-switched production and account for certain switches and not others. Moreover, 4-M model distinguishes between three sub-categories of system morphemes which together with content morphemes are activated at different levels of representation. That is, content morphemes that receive or assign a thematic role and *early system morphemes* (e.g., nominal plural) that are associated with co-occurring content morphemes are activated and directly elected at lemma level. *Late bridge system morphemes* (e.g., possessive "of") acquire the information they need within the maximal projection they occur and are activated and indirectly elected at formulator level. Finally, *late outsider system morphemes* (e.g., morphemes used in agreement) acquire the information they need outside their maximal projection and are activated at positional level (Myers-Scotton, 2002). The aforementioned morpheme classification and activation could accommodate the pattern of results we obtained in our experiments in the following way: according to 4-M model, the singular English head noun (*hair*) and its plural Greek translation equivalent (*μαλλιά*) would be activated at the early stage of lemma. The verb would only be provided with the necessary information for agreement when all constituents would have taken their appropriate places. Thus, the fact that the verb was produced in a different number than the subject noun more often than not in L2sg-L1pl switch might imply that the L1 Greek plural translation activated in parallel with its English rival at the lemma level had proceeded and taken the subject slot of the latter at positional level passing its plural number to the produced verb.

6.1.5 A Model of Number Agreement Construction in Bilingual Sentence Production

If we assume an extension of the Matrix Language Frame model, in keeping with Levelt et al. (1999), our bilinguals' performance could be accommodated in the following way. In the monolingual mode experiments, we assume that activation of the response language was constantly higher than the activation of the non-response language due to the monolingual nature of the task. Thus, verb-agreement would be constructed as in monolingual speech, following the syntactic restrictions of the intended language. However, our account allows the possibility of influence from the non-response language if the latter is morphophonologically richer than the response language (e.g., the case of Greek).

In the bilingual mode experiments, speakers were aware that the task they had to perform involved language alternation. They were instructed that the language cue would signal the language-switch, so both languages were presumably activated as soon as bilinguals were exposed to the item. During subject-verb agreement construction, that is, at the stage of *grammatical encoding* (Bock & Levelt, 1994), a head noun is selected for a noun phrase (NP). This operation comprises processes such as selection of that noun's grammatical features and function assignment of the noun. In our experiments, the subject noun was already provided, but because of the bilingual mode of the task, we assume that the corresponding lemma in the other language was also highly activated. What should follow next is selection of the predicate in the response language and retrieval of its grammatical features. When the source language of the switch was the L1 (L1-L2 direction), the competition between the source and the target language lemmas would overcome the inhibition of the L1 and resolve in its favour due to the higher frequency, dominance, and most crucially, plural syntactic properties of the native language which would render the L1 a stronger competitor and the L2 particularly vulnerable. Thus, the L1 plural lemma would override the syntactic properties specified by the L2 singular lemma and pass its plural number to the verb, when syntactic constituents in the L2 were hierarchically integrated into a processing structure before they were articulated. Influence of the L1 was evident also when the source language of the switch was the L2 (L2-L1 direction), and it was even greater when the L2 subject noun diverged in number from the L1 translation of the target language both morphologically and notionally.

Thus, for Greek-English bilinguals we suggest that, apart from the account of markedness of a singular subject noun vs. a plural counterpart (*hair* vs. *μαλλιά*) (Eberhard, 1997), they tended to produce a verb in plural after an L2 singular divergent subject noun (*hair*) because that noun differed from the Greek translation equivalent not only morphologically but notionally too. In other words, the most salient feature (here plurality) would dictate verb-agreement. Following this reasoning, "double-divergence" of the same category of nouns (*μαλλιά*; 'hair') might have led English bilinguals in L2-L1 direction to singular verb production. (Figure 15 presents a model of sentence construction in code-switched production with divergent subject nouns, that is, when the number of the subject diverges from its translation both morphologically and notionally). For subject nouns that shared some number features across the two languages in L2-L1 direction, the lemma that seemed to prevail was the lemma that created the lowest degree of clash between the two language systems in the process of concept-lemma mapping. At any rate, the strongest candidate that would emerge either because of its enforced divergence or because of its convergence with features from both languages would spread its activation to the lemma nodes of the target language so that the verb would acquire that lemma's feature specification.

(Choice of Message-to-communicate & of Language-to-speak)

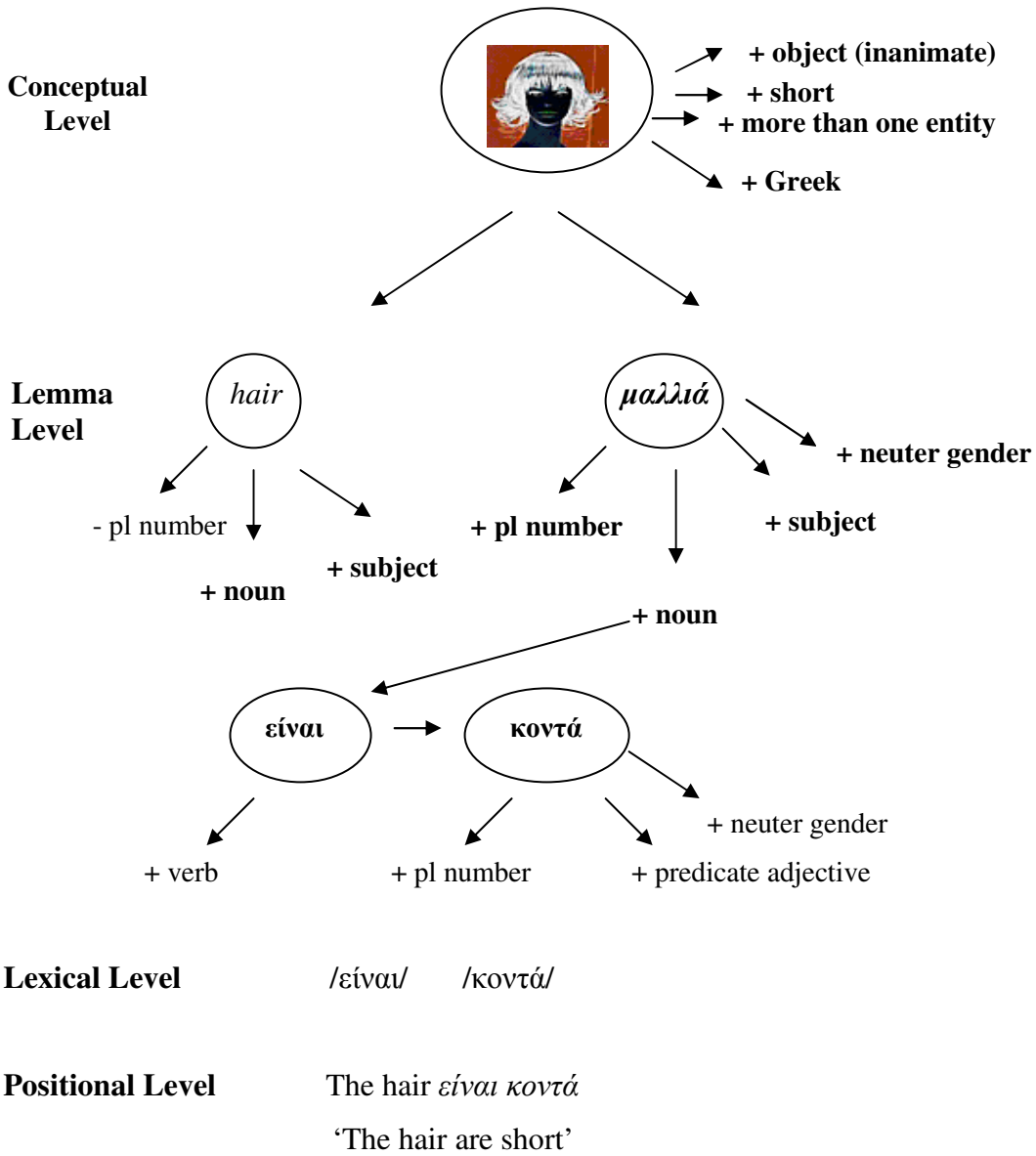

Figure 15. Sentence construction in CS, showing the dominant effects of plurality. Bold form indicates higher level of activation.

6.2 Directions for Future Research

In this thesis, we examined bilingual sentence processing in the monolingual and the bilingual modes in which the contrasting syntactic properties of English and Greek were manipulated. Apart from effects of language integration, we also obtained evidence for parallel language activation and influence of the non-target language especially in the bilingual mode where code-switching was involved. In our experiments we investigated the effects of number divergence and mode of speech, but there are a number of other factors that are reported in the bilingualism literature that may also affect bilingual language control and production which would be worthwhile to explore in the future.

We could examine whether evidence for language interaction effects can generalize, and if so to what extent, to other grammatical aspects across languages as some features are more easily transferred than others (Thomason, 1991; White, 2000). For instance, we could explore whether there is a difference in the degree of occurrence of language interference depending on the features' position in the Feature Hierarchy (Person > Number > Gender). For example, we might expect number interference to occur more often than gender interference. We could also examine whether any such difference varies within and across languages. Could we predict cases of interference based on features' cognitive salience as it has been suggested in studies comparing number and gender information processing? (Nicol, 1988; Di Domenico & De Vincenzi, 1995; Carminati, 2005). In the same line, Costa (2004) argues that further research on cross-linguistic effects of grammatical features may show that the *language specific* and *non-specific* hypotheses can apply to differential linguistic information.

It has been suggested that bilinguals, for example, of a different language pair or fluency, do not necessarily process language in the same way as other bilinguals, mainly because speakers of different languages may rely on different cues to process or produce bilingual speech (Romaine, 1995). That is, differences in language processing may depend on the structural differences between languages and the specific linguistic and extra-linguistic cues bilingual speakers take into account during this processing. For example, MacWhinney, Bates and Kliegl (1984) mention that Italian speakers appear to rely more on verb marking, whereas English speakers rely more on word order, when they have to decide upon the subject of a sentence. In addition, the level of fluency in the two languages may affect language control

and processing, accordingly (e.g., Green, 2003; Costa & Santesteban, 2004; Costa et al., 2006). Therefore, it would be worth testing whether our findings would be replicated in speakers of other language pairs and levels of fluency.

We could further manipulate characteristics of the stimuli (e.g., length of the subject noun phrases and/or whether the subject NP already involves some code-switching) and examine their effects on the degree of preference for the chosen language. It would also be interesting to investigate the effects of the above manipulations on language processing as a function of the task at hand. That is, we could compare CS performance under time-constrained tasks against CS discourse outside the laboratory (see also Myers-Scotton, 2006). The combination of these two approaches would be ideal because, despite the fact that naturalistic data can provide useful information towards building bilingual production models, an experimental approach is imperative to examine the effects of psycholinguistic variables on bilingual sentence processing under controlled conditions (Grosjean, 1997a). Thus, we argue in support of more reliable measurements of code-switched speech since psycholinguistic techniques to study CS are not yet well developed (Muysken, 1995).

In our experiments we studied the performance of fluent bilinguals. It would be interesting to examine how balanced bilinguals would perform on the same experimental conditions. Kroll and Tokowicz (2005) stress the importance of the cultural context within which L1 and L2 have been acquired by late bilinguals and argue that it is more likely for bilingual speakers to assess translation equivalents as sharing the same meaning when the two languages are learned in the same cultural context than when not (see also Pavlenko, 2005). If that claim is valid, then we would not expect English-Greek balanced bilinguals to display notional differentiation in their responses in comparison to Greek-English balanced bilinguals. In linguistic terms, interference of the semantics of L1 in L2 syntax processing can be attributed to the dominance of the semantic interpretability of features in the L1 which may persist even in proficient bilinguals (Sanz & Bever, 2001). In other words, it is difficult especially for late bilinguals to change the already established feature classification in L1 to a different one so as to be compatible with the grammar of the L2 (e.g., *hair* [- plural] instead of [+ plural] for Greek-English bilinguals). Therefore, an investigation of number divergence across languages with balanced (ideally

early) bilinguals could show how language and thought interact in speakers who acquire divergent features of two languages simultaneously.

Another issue for future research could be the course it takes a bilingual to process code-switched utterances in a reading comprehension or a decision task versus a production task, because certain elicitation tasks may trigger more interlingual errors than other tasks (Dulay, 1982). A comparison between these tasks could also be examined in relation to speakers' L2 fluency. Moreover, we could study the effects of age of acquisition and L2 fluency in bilingual language representation and production by varying the level of these two factors. Would early L2 learners behave in a different way than L2 late learners? For example, Athanasopoulos (2006) provides evidence of how the acquisition of specific L2 grammatical properties may affect bilingual cognition and that cognition may correlate with proficiency in the L2. In his study, intermediate and advanced Japanese-English bilinguals were shown an original picture and then sets of other pictures. Each group's task was to identify the picture that resembled most the original one. The author was interested in bilinguals' patterns of sensitivity to number changes between animate and inanimate entities as in Japanese the former can take plural marking whereas the latter may express countability only by means of classifiers. The results showed that the above distinction was still prominent in the intermediate group of L2 speakers whereby number changes in pictures with animate entities were perceived more easily than in pictures with inanimate entities but not in the advanced L2 speakers who behaved more like English monolinguals.

The focus of this thesis was to examine the mechanisms that underlie bilingual sentence processing and the interaction of the syntactic properties of a bilingual's language systems. Our findings provide support for language activation of the non-response language both in the monolingual and the bilingual modes, the level of which may be regulated by factors such as language dominance, feature salience, and processing requirements of the task at hand. This thesis contributes to the field of bilingualism by providing evidence of language interaction effects at sentential level on number agreement, contrasting two languages that have not been investigated under this light before. In addition, by examining code-switched production under controlled conditions we contribute to the development of research in the field of code-switching using a well-accepted experimental paradigm from psycholinguistics.

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APPENDIX A

Materials for Experiments 1-5: English materials were used in Expt. 1, Greek materials were used in Expt. 2, and all materials were used in Expts. 3, 4, & 5

English plural divergent nouns	Greek singular divergent nouns
The scissors	Το ψαλίδι
The pincers	Η πένσα
The scales	Η ζυγαριά
The nail clippers	Ο νυχοκόπτης
The nutcrackers	Ο καρυοθραύστης
The tweezers	Το τσιμπίδι των φρυδιών
The gallows	Η κρεμάλα
The trousers	Το παντελόνι
The shorts	Το σορτσάκι
The tights	Το καλσόν
The bermudas	Η βερμούδα
The briefs	Η κιλότα
The culottes	Η ζιπ κιλότ
The swimming trunks	Το ανδρικό μαγιό
The pants	Το σλιπάκι
The jeans	Το τζιν
The corduroys	Το κοτλέ
The knickers	Το βρακί
The wages	Ο μισθός
The looks	Η εμφάνιση
The surroundings	Ο περίγυρος
The police	Η αστυνομία
The fire brigade	Η πυροσβεστική
The mains	Ο κεντρικός αγωγός

English singular divergent nouns	Greek plural divergent nouns
The hair	Τα μαλλιά
The ransom	Τα λύτρα
The cash	Τα ψιλά
The money	Τα λεφτά
The birthday	Τα γενέθλια
The inauguration	Τα εγκαίνια
The baggage	Οι αποσκευές
The rubbish	Τα απορρίμματα
The news	Τα νέα

The evidence	Τα στοιχεία
The information	Οι πληροφορίες
The economics	Τα οικονομικά
The athletics	Τα αθλητικά
Mathematics	Τα μαθηματικά
The sanitary ware	Τα είδη υγιεινής
The carol	Τα κάλαντα
The youth	Τα νιάτα
The tortellini	Τα τορτελλίνι
The spaghetti	Τα σπαγγέτι
The spell	Τα μάγια
Knowledge	Οι γνώσεις
Midnight	Τα μεσάνυχτα
Chinese	Τα Κινέζικα
Christmas	Τα Χριστούγεννα

English singular convergent nouns (single-language condition)	**Greek singular convergent nouns (single-language condition)**
The tree	Το δέντρο
The school	Το σχολείο
The door	Η πόρτα
The room	Το δωμάτιο
The cassette	Η κασέτα
The window	Το παράθυρο
The apple	Το μήλο
The chair	Η καρέκλα
The chocolate	Η σοκολάτα
The song	Το τραγούδι
The word	Η λέξη
The flower	Το λουλούδι
The river	Το ποτάμι
The table	Το τραπέζι
The ship	Το καράβι
The hotel	Το ξενοδοχείο
The bag	Η τσάντα
The bed	Το κρεβάτι
The bottle	Το μπουκάλι
The bus	Το λεωφορείο
The cigarette	Το τσιγάρο
The car	Το αυτοκίνητο
The egg	Το αβγό
The toy	Το παιχνίδι

English singular convergent nouns (CS condition)	**Greek singular convergent nouns (CS condition)**
The pocket	Η τσέπη
The lady	Η κυρία
The gun	Το όπλο
The body	Το σώμα
The drink	Το ποτό
The business	Η επιχείρηση
The hat	Το καπέλο
The king	Ο βασιλιάς
The relationship	Η σχέση
The girl	Το κορίτσι
The head	Το κεφάλι
The surprise	Η έκπληξη
The week	Η εβδομάδα
The color	Το χρώμα
The carrot	Το καρότο
The town	Η πόλη
The kitchen	Η κουζίνα
The biscuit	Το μπισκότο
The village	Το χωριό
The program	Το πρόγραμμα
The day	Η μέρα
The umbrella	Η ομπρέλα
The dog	Ο σκύλος
The bill	Ο λογαριασμός

English plural convergent nouns (single-language condition)	**Greek plural convergent nouns (single-language condition)**
The lights	Τα φώτα
The cats	Οι γάτες
The books	Τα βιβλία
The airplanes	Τα αεροπλάνα
The phrases	Οι φράσεις
The mistakes	Τα λάθη
The knives	Τα μαχαίρια
The examples	Τα παραδείγματα
The trains	Τα τραίνα
The names	Τα ονόματα
The cards	Τα χαρτιά
The experiments	Τα πειράματα
The telephones	Τα τηλέφωνα

The questions	Οι ερωτήσεις
The results	Τα αποτελέσματα
The teachers	Οι δάσκαλοι
The snakes	Τα φίδια
The steps	Τα βήματα
The answers	Οι απαντήσεις
The hopes	Οι ελπίδες
The clouds	Τα σύννεφα
The tomatoes	Οι ντομάτες
The bicycles	Τα ποδήλατα
The boys	Τα αγόρια

English plural convergent nouns (CS condition)	**Greek plural convergent nouns (CS condition)**
The gardens	Οι κήποι
The houses	Τα σπίτια
The keys	Τα κλειδιά
The pages	Οι σελίδες
The rings	Τα δαχτυλίδια
The shops	Τα μαγαζιά
The stars	Τα αστέρια
The roads	Οι δρόμοι
The balls	Οι μπάλες
The hospitals	Τα ξενοδοχεία
The pencils	Τα μολύβια
The prices	Οι τιμές
The dolls	Οι κούκλες
The walls	Οι τοίχοι
The drugs	Τα ναρκωτικά
The rocks	Οι πέτρες
The flats	Τα διαμερίσματα
The years	Τα χρόνια
The magazines	Τα περιοδικά
The photos	Οι φωτογραφίες
The bananas	Οι μπανάνες
The plates	Τα πιάτα
The radios	Τα ραδιόφωνα
The potatoes	Οι πατάτες
The lights	Τα φώτα
The cats	Οι γάτες
The books	Τα βιβλία
The airplanes	Τα αεροπλάνα
The phrases	Οι φράσεις

The mistakes	Τα λάθη
The knives	Τα μαχαίρια
The examples	Τα παραδείγματα
The trains	Τα τραίνα
The names	Τα ονόματα
The cards	Τα χαρτιά
The experiments	Τα πειράματα
The telephones	Τα τηλέφωνα
The questions	Οι ερωτήσεις

APPENDIX B

Materials and instructions for the Grammaticality Judgement Task:
English materials were used in Expt. 1, Greek materials were used in Expt. 2,
and all materials were used in Expts. 4 & 5.

Please read each pair of sentences and circle which of the two sentences you consider grammatically correct.

Παρακαλώ διαβάστε κάθε ζεύγος προτάσεων και κυκλώστε την πρόταση που θεωρείτε γραμματικά σωστή.

A. The hair is short B. The hair are short	A. Τα μαλλιά είναι κοντά B. Τα μαλλιά είναι κοντό
A. The baggage are big B. The baggage is big	A. Οι αποσκευές είναι μεγάλη B. Οι αποσκευές είναι μεγάλες
A. The athletics are boring B. The athletics is boring	A. Τα αθλητικά είναι βαρετά B. Τα αθλητικά είναι βαρετά
A. The economics are interesting B. The economics is interesting	A. Τα οικονομικά είναι ενδιαφέρον B. Τα οικονομικά είναι ενδιαφέροντα
A. The birthday is important B. The birthday are important	A. Τα γενέθλια είναι σημαντικά B. Τα γενέθλια είναι σημαντικό
A. The carol is nice B. The carol are nice	A. Τα κάλαντα είναι ωραία B. Τα κάλαντα είναι ωραίο
A. Christmas is joyful B. Christmas are joyful	A. Τα Χριστούγεννα είναι χαρούμενα B. Τα Χριστούγεννα είναι χαρούμενο
A. The sanitary ware are expensive B. The sanitary ware is expensive	A. Τα είδη υγιεινής είναι ακριβό B. Τα είδη υγιεινής είναι ακριβά
A. The evidence is good B. The evidence are good	A. Τα στοιχεία είναι καλά B. Τα στοιχεία είναι καλό

A. The news are bad B. The news is bad	A. Τα νέα είναι άσχημο B. Τα νέα είναι άσχημα
A. Knowledge are useful B. Knowledge is useful	A. Οι γνώσεις είναι χρήσιμη B. Οι γνώσεις είναι χρήσιμες
A. The inauguration is tomorrow B. The inauguration are tomorrow	A. Τα εγκαίνια αρχίζουν αύριο B. Τα εγκαίνια αρχίζει αύριο
A. The spaghetti are raw B. The spaghetti is raw	A. Τα σπαγγέτι είναι άψητο B. Τα σπαγγέτι είναι άψητα
A. The information is misleading B. The information are misleading	A. Οι πληροφορίες είναι παραπλανητικές B. Οι πληροφορίες είναι παραπλανητική
A. Chinese are difficult B. Chinese is difficult	A. Τα Κινέζικα είναι δύσκολο B. Τα Κινέζικα είναι δύσκολα
A. The ransom are small B. The ransom is small	A. Τα λύτρα είναι λίγο B. Τα λύτρα είναι λίγα
A. The spell is scary B. The spell are scary	A. Τα μάγια είναι τρομακτικά B. Τα μάγια είναι τρομακτικό
A. Mathematics are complex B. Mathematics is complex	A. Τα μαθηματικά είναι περίπλοκο B. Τα μαθηματικά είναι περίπλοκα
A. Midnight is coming B. Midnight are coming	A. Τα μεσάνυχτα έρχονται B. Τα μεσάνυχτα έρχεται
A. The cash is enough B. The cash are enough	A. Τα ψιλά είναι αρκετά B. Τα ψιλά είναι αρκετό
A. The tortellini are tasty B. The tortellini is tasty	A. Τα τορτελλίνι είναι νόστιμο B. Τα τορτελλίνι είναι νόστιμα
A. The youth is rebellious B. The youth are rebellious	A. Τα νιάτα είναι επαναστατικά B. Τα νιάτα είναι επαναστατικό
A. The money are little B. The money is little	A. Τα λεφτά είναι λίγο B. Τα λεφτά είναι λίγα
A. The rubbish is smelly B. The rubbish are smelly	A. Τα απορρίμματα μυρίζουν B. Τα απορρίμματα μυρίζει

A. The trousers is black	A. Το παντελόνι είναι μαύρα
B. The trousers are black	B. Το παντελόνι είναι μαύρο
A. The nail clippers are sharp	A. Ο νυχοκόπτης είναι κοφτερός
B. The nail clippers is sharp	B. Ο νυχοκόπτης είναι κοφτεροί
A. The briefs is cheap	A. Η κιλότα είναι φθηνές
B. The briefs are cheap	B. Η κιλότα είναι φθηνή
A. The pants are big	A. Το σλιπάκι είναι μεγάλο
B. The pants is big	B. Το σλιπάκι είναι μεγάλα
A. The tights is green	A. Το καλσόν είναι πράσινα
B. The tights are green	B. Το καλσόν είναι πράσινο
A. The jeans are new	A. Το τζην είναι καινούριο
B. The jeans is new	B. Το τζην είναι καινούρια
A. The mains is broken	A. Ο κεντρικός αγωγός είναι σπασμένοι
B. The mains are broken	B. Ο κεντρικός αγωγός είναι σπασμένος
A. The corduroys are tight	A. Το κοτλέ είναι στενό
B. The corduroys is tight	B. Το κοτλέ είναι στενά
A. The gallows is wooden	A. Η κρεμάλα είναι ξύλινες
B. The gallows are wooden	B. Η κρεμάλα είναι ξύλινη
A. The looks are deceiving	A. Η εμφάνιση είναι παραπλανητική
B. The looks is deceiving	B. Η εμφάνιση είναι παραπλανητικές
A. The swimming trunks is red	A. Το μαγιό είναι κόκκινα
B. The swimming trunks are red	B. Το μαγιό είναι κόκκινο
A. The wages are low	A. Ο μισθός είναι χαμηλός
B. The wages is low	B. Ο μισθός είναι χαμηλοί
A. The surroundings is pleasant	A. Ο περίγυρος είναι ευχάριστοι
B. The surroundings are pleasant	B. Ο περίγυρος είναι ευχάριστος
A. The police are fearless	A. Η αστυνομία είναι ατρόμητη
B. The police is fearless	B. Η αστυνομία είναι ατρόμητες
A. The knickers is white	A. Το βρακί είναι άσπρα
B. The knickers are white	B. Το βρακί είναι άσπρο

A. The tweezers are useful	A. Το τσιμπίδι των φρυδιών είναι χρήσιμο
B. The tweezers is useful	B. Το τσιμπίδι των φρυδιών είναι χρήσιμα
A. The bermudas are long	A. Η βερμούδα είναι μακριά
B. The bermudas is long	B. Η βερμούδα είναι μακριές
A. The shorts is old	A. Το σορτσάκι είναι παλιά
B. The shorts are old	B. Το σορτσάκι είναι παλιό
A.The nutcrackers are strong	A. Ο καρυοθραύστης είναι γερός
B. The nutcrackers is strong	B. Ο καρυοθραύστης είναι γεροί
A. The scissors is sharp	A. Το ψαλίδι είναι κοφτερά
B. The scissors are sharp	B. Το ψαλίδι είναι κοφτερό
A. The scales are adjusted	A. Η ζυγαριά είναι ρυθμισμένη
B. The scales is adjusted	B. Η ζυγαριά είναι ρυθμισμένες
A. The fire brigade is indispensable	A. Η πυροσβεστική είναι απαραίτητες
B. The fire brigade are indispensable	B. Η πυροσβεστική είναι απαραίτητη
A. The culottes are wet	A. Η ζιπ κιλότ είναι βρεγμένη
B. The culottes is wet	B. Η ζιπ κιλότ είναι βρεγμένες
A. The pincers is rusty	A. Η πένσα είναι σκουριασμένες
B. The pincers are rusty	B. Η πένσα είναι σκουριασμένη
A. The tree is green	A. Το δέντρο είναι πράσινο
B. The tree are green	B. Το δέντρο είναι πράσινα
A. The school are open	A. Το σχολείο είναι ανοιχτά
B. The school is open	B. Το σχολείο είναι ανοιχτό
A. The door are grey	A. Η πόρτα είναι γκρίζες
B. The door is grey	B. Η πόρτα είναι γκρίζα
A. The room is dark	A. Το δωμάτιο είναι σκοτεινό
B. The room are dark	B. Το δωμάτιο είναι σκοτεινά
A. The tape is empty	A. Η κασέτα είναι άδεια
B. The tape are empty	B. Η κασέτα είναι άδειες

A. The window are narrow B. The window is narrow	A. Το παράθυρο είναι στενά B. Το παράθυρο είναι στενό
A. The apple is sweet B. The apple are sweet	A. Το μήλο είναι γλυκό B. Το μήλο είναι γλυκά
A. The chair are comfortable B. The chair is comfortable	A. Η καρέκλα είναι αναπαυτικές B. Η καρέκλα είναι αναπαυτική
A. The chocolate is bitter B. The chocolate are bitter	A. Η σοκολάτα είναι πικρή B. Η σοκολάτα είναι πικρές
A. The song is famous B. The song are famous	A. Το τραγούδι είναι γνωστό B. Το τραγούδι είναι γνωστά
A. The word are bad B. The word is bad	A. Η λέξη είναι κακές B. Η λέξη είναι κακή
A. The flower is yellow B. The flower are yellow	A. Το λουλούδι είναι κίτρινο B. Το λουλούδι είναι κίτρινα
A. The week is long B. The week are long	A. Η εβδομάδα είναι μεγάλη B. Η εβδομάδα είναι μεγάλες
A. The color is vivid B. The color are vivid	A. Το χρώμα είναι ζωντανό B. Το χρώμα είναι ζωντανά
A. The carrot are big B. The carrot is big	A. Το καρότο είναι μεγάλα B. Το καρότο είναι μεγάλο
A. The town is full B. The town are full	A. Η πόλη είναι γεμάτη B. Η πόλη είναι γεμάτες
A. The kitchen are clean B. The kitchen is clean	A. Η κουζίνα είναι καθαρές B. Η κουζίνα είναι καθαρή
A. The biscuit is soft B. The biscuit are soft	A. Το μπισκότο είναι μαλακό B. Το μπισκότο είναι μαλακά
A. The village is mountainous B. The village are mountainous	A. Το χωριό είναι ορεινό B. Το χωριό είναι ορεινά

A. The programme are strict B. The programme is strict	A. Το πρόγραμμα είναι αυστηρά B. Το πρόγραμμα είναι αυστηρό
A. The day is short B. The day are short	A. Η μέρα είναι μικρή B. Η μέρα είναι μικρές
A. The umbrella is huge A. The umbrella are huge	A. Η ομπρέλα είναι τεράστια B. Η ομπρέλα είναι τεράστιες
A. The dog are friendly B. The dog is friendly	A. Ο σκύλος είναι φιλικοί B. Ο σκύλος είναι φιλικός
A. The bill is enormous B. The bill are enormous	A.Ο λογαριασμός είναι υπέρογκος B. Ο λογαριασμός είναι υπέρογκοι
A. The books is old B. The books are old	A. Τα βιβλία είναι παλιό B. Τα βιβλία είναι παλιά
A. The lights are dim B. The lights is dim	A. Τα φώτα είναι θολά B. Τα φώτα είναι θολό
A. The cats is small B. The cats are small	A. Οι γάτες είναι μικρή B. Οι γάτες είναι μικρές
A. The airplanes are full B. The airplanes is full	A. Τα αεροπλάνα είναι γεμάτα B. Τα αεροπλάνα είναι γεμάτο
A. The phrases are weird B. The phrases is weird	A. Οι φράσεις είναι παράξενες B. Οι φράσεις είναι παράξενη
A. The mistakes is serious B. The mistakes are serious	A. Τα λάθη είναι σοβαρό B. Τα λάθη είναι σοβαρά
A. The knives is dangerous B. The knives are dangerous	A. Τα μαχαίρια είναι επικίνδυνο B. Τα μαχαίρια είναι επικίνδυνα
A. The examples are bad B. The examples is bad	A. Τα παραδείγματα είναι κακά B. Τα παραδείγματα είναι κακό
A. The trains are fast B. The trains is fast	A. Τα τραίνα είναι γρήγορα B. Τα τραίνα είναι γρήγορο
A. The names is foreign B. The names are foreign	A. Τα ονόματα είναι ξένο B. Τα ονόματα είναι ξένα

A. The cards is amusing	A. Τα χαρτιά είναι διασκεδαστικό
B. The cards are amusing	B. Τα χαρτιά είναι διασκεδαστικά
A. The experiments are successful	A. Τα πειράματα είναι επιτυχημένα
B. The experiments is successful	B. Τα πειράματα είναι επιτυχημένο
A. The telephones is busy	A. Τα τηλέφωνα είναι κατειλημμένο
B. The telephones are busy	B. Τα τηλέφωνα είναι κατειλημμένα
A. The questions are easy	A. Οι ερωτήσεις είναι εύκολες
B. The questions is easy	B. Οι ερωτήσεις είναι εύκολη
A. The gardens are green	A. Οι κήποι είναι πράσινοι
B. The gardens is green	B. Οι κήποι είναι πράσινο
A. The houses are beautiful	A. Τα σπίτια είναι όμορφα
B. The houses is beautiful	B. Τα σπίτια είναι όμορφο
A. The keys are plastic	A. Τα κλειδιά είναι πλαστικά
B. The keys is plastic	B. Τα κλειδιά είναι πλαστικό
A. The pages is old	A. Οι σελίδες είναι παλιά
B. The pages are old	B. Οι σελίδες είναι παλιές
A. The rings is valuable	A. Τα δαχτυλίδια είναι πολύτιμο
B. The rings are valuable	B. Τα δαχτυλίδια είναι πολύτιμα
A. The shops are empty	A. Τα μαγαζιά είναι άδεια
B. The shops is empty	B. Τα μαγαζιά είναι άδειο
A. The stars are bright	A. Τα άστρα είναι φωτεινά
B. The stars is bright	B. Τα άστρα είναι φωτεινό
A. The roads is narrow	A. Οι δρόμοι είναι στενός
B. The roads are narrow	B. Οι δρόμοι είναι στενοί
A. The walls are tall	A. Οι τοίχοι είναι ψηλοί
B. The walls is tall	B. Οι τοίχοι είναι ψηλός
A. The hospitals is private	A. Τα νοσοκομεία είναι ιδιωτικό
B. The hospitals are private	B. Τα νοσοκομεία είναι ιδιωτικά

APPENDIX C

Materials for the Norming Study used in Experiments 3, 4, & 5

To avoid repetition we report that materials for the norming studies were identical to those we used for the experimental trials of the corresponding experiments (see Materials for Expts. 3, 4, & 5). Below are the instructions:

If you were thinking about each one of the following words, would you be thinking about it as "one thing" or "more than one thing"?

Please rate on a 7-point scale:

1 **2** **3** **4** **5** **6** 7

one thing many things

(Write the rating number next to each one of the following words)

APPENDIX D

Materials for Experiments 6, 7, 8 & 9

Divergent & Semantically Related-to-Divergent Nouns in English (singular number)	**Divergent & Semantically Related-to-Divergent Nouns in Greek (plural number)**
The hair/wig of the girl got wet	Τα μαλλιά/οι περούκες του κοριτσιού βράχηκαν
The ransom/amount for the kidnapping got lost	Τα λύτρα/ποσά της απαγωγής χάθηκαν
The carol/hymn for the ceremony got cancelled	Τα κάλαντα/οι ύμνοι για την τελετή ακυρώθηκαν
The inauguration/repair of the shop got started	Τα εγκαίνια/οι επισκευές του μαγαζιού άρχισαν
The spell/power of evil got broken	Τα μάγια/οι δυνάμεις του κακού λύθηκαν
The baggage/suitcase of the tourist got found	Οι αποσκευές/οι βαλίτσες του τουρίστα βρέθηκαν
The rubbish/leftover in the bin got smelly	Τα απορρίμματα/αποφάγια στο καλάθι μύρισαν
The economics/service of the country got worse	Τα οικονομικά/οι υπηρεσίες της χώρας χειροτέρευσαν
The news/programme on the radio got better	Τα νέα/προγράμματα στο ράδιο βελτιώθηκαν
The cash/coin in the pocket got lost	Τα ψιλά/κέρματα στην τσέπη χάθηκαν
The athletics/sport on the television got announced	Τα αθλητικά/αθλήματα στην τηλεόραση ανακοινώθηκαν
Mathematics/the exercise in the book got difficult	Τα μαθηματικά/οι ασκήσεις στο βιβλίο δυσκόλεψαν
The money/cheque for the bill got cashed	Τα λεφτά/οι επιταγές για το λογαριασμό εξαργυρώθηκαν
The change/share from the banknote got used	Τα ρέστα/μερίδια από το χαρτονόμισμα ξοδεύτηκαν
The graphics/print in the magazine got better	Τα γραφικά/οι εκτυπώσεις στο περιοδικό βελτιώθηκαν
The evidence/indication for the crime got covered up	Τα στοιχεία/οι ενδείξεις για το έγκλημα καλύφθηκαν
The birthday/anniversary of the woman got organised	Τα γενέθλια/οι επέτειοι της γυναίκας οργανώθηκαν
The spaghetti/noodle in the pan got overcooked	Τα σπαγγέτι/μακαρονάκια στην κατσαρόλα παραψήθηκαν
Chinese/the text in the book got difficult	Τα Κινέζικα/κείμενα στο βιβλίο δυσκόλεψαν
Christmas/the celebration in Lapland got cancelled	Τα Χριστούγεννα/οι γιορτές στη Λαπωνία ακυρώθηκαν

Divergent & Semantically Related-to-Divergent Nouns in English (plural number)	**Divergent & Semantically Related-to-Divergent Nouns in Greek (singular number)**
The shorts/clothes of the girl got creased	Το σορτσάκι/ρούχο του κοριτσιού τσαλακώθηκε
The trousers/shirts of the boy got shrunk	Το παντελόνι/πουκάμισο του αγοριού στένεψε
The tongs/shovels at the fireplace got rusty	Η λαβίδα/το φτυάρι στο τζάκι σκούριασε
The scissors/paper-knives in the drawer got borrowed	Το ψαλίδι/ο χαρτοκόπτης στο συρτάρι δανείστηκε
The police/services in the prison got better	Η αστυνομία/υπηρεσία στη φυλακή βελτιώθηκε
The surroundings/relationships of the boy got worse	Ο περίγυρος/η σχέση του αγοριού χειροτέρευσε
The scales/tiles in the bathroom got old	Η ζυγαριά/το πλακάκι στο μπάνιο πάλιωσε
The pants/suits of the boy got stained	Το σλιπάκι/κοστούμι του αγοριού λεκιάστηκε
The looks/impressions of the boy got better	Η εμφάνιση/εντύπωση του αγοριού βελτιώθηκε
The wages/responsibilities from the job got higher	Ο μισθός/η ευθύνη στη δουλειά μεγάλωσε
The nail clippers/knives on the table got rusty	Ο νυχοκόπτης/το μαχαίρι στο τραπέζι σκούριασε
The tights/socks of the girl got worn out	Το καλσόν/η κάλτσα του κοριτσιού πάλιωσε
The nutcrackers/tools in the drawer got old	Ο καρυοθραύστης/το εργαλείο στο συρτάρι πάλιωσε

The pincers/machines in the tool-room got broken	Η πένσα/το μηχάνημα στην αποθήκη έσπασε
The βermudas/dresses of the doll got dusty	Η βερμούδα/το φόρεμα της κούκλας σκονίστηκε
The jeans/scarves in the kitchen got dirty	Το τζην/κασκόλ στην κουζίνα λερώθηκε
The knickers/skirts of the girl got creased	Το βρακί/η φούστα του κοριτσιού τσαλακώθηκε
The compasses/pencil-sharpeners in the case got rusty	Ο διαβήτης/η ξύστρα στην κασετίνα σκούριασε
The tweezers/eye pencils in the cupboard got lost	Το τσιμπίδι φρυδιών/μολύβι ματιών στο ντουλάπι χάθηκε
The gallows/benches in the square got wet	Η κρεμάλα/το παγκάκι στην πλατεία βράχηκε

Convergent (Semantically Unrelated) Nouns in English (singular number)	**Convergent (Semantically Unrelated) Nouns in Greek (singular number)**
The tree in the garden got sold	Το δέντρο στον κήπο πουλήθηκε
The school in the village got closed	Το σχολείο στο χωριό έκλεισε
The door of the car got stuck	Η πόρτα του αυτοκινήτου κόλλησε
The bill in the hotel got paid	Ο λογαριασμός στο ξενοδοχείο πληρώθηκε
The tape in the tape-recorder got broken	Η κασέτα στο κασετόφωνο έσπασε
The window in the loft got stuck	Το παράθυρο στη σοφίτα κόλλησε
The apple in the bowl got mouldy	Το μήλο στο μπώλ μούχλιασε
The chair in the office got broken	Η καρέκλα στο γραφείο έσπασε
The color of the flag got paler	Το χρώμα της σημαίας ξεθώριασε
The song on the radio got interrupted	Το τραγούδι στο ράδιο διακόπηκε
The word in the poem got edited	Η λέξη στο ποίημα γράφτηκε
The flower in the park got cut	Το λουλούδι στο πάρκο κόπηκε
The river in the city got dried	Το ποτάμι στην πόλη ξεράθηκε
The table in the store-room got old	Το τραπέζι στην αποθήκη πάλιωσε
The ship in the port got sold	Το πλοίο στο λιμάνι πουλήθηκε
The hotel in the brochure got advertised	Το ξενοδοχείο στο περιοδικό διαφημίστηκε
The car of the man got stolen	Το αυτοκίνητο του άντρα κλάπηκε
The bottle in the fridge got chilled	Το μπουκάλι στο ψυγείο πάγωσε
The bus to the city got delayed	Το λεωφορείο για την πόλη άργησε
The animal in the tale got killed	Το ζώο στο παραμύθι σκοτώθηκε

Convergent (Semantically Unrelated) Nouns in English (plural number)	**Convergent (Semantically Unrelated) Nouns in Greek (plural number)**
The books in the library got stolen	Τα βιβλία στη βιβλιοθήκη κλάπηκαν
The drinks at the party got consumed	Τα ποτά στο πάρτυ καταναλώθηκαν
The biscuits in the tin got eaten	Τα μπισκότα στο κουτί φαγώθηκαν
The mistakes in the test got corrected	Τα λάθη στο διαγώνισμα διορθώθηκαν
The trains to the city got bombed	Τα τραίνα στην πόλη βομβαρδίστηκαν
The telephones in the shop got stolen	Τα τηλέφωνα στο μαγαζί κλάπηκαν
The clouds in the sky got dark	Τα σύννεφα στον ουρανό σκούριναν
The keys for the locker got lost	Τα κλειδιά του ντουλαπιού χάθηκαν
The shops on the beach got destroyed	Τα μαγαζιά στην παραλία καταστράφηκαν
The targets of the girl got achieved	Οι στόχοι του κοριτσιού πέτυχαν

The magazines at the counter got sold	Τα περιοδικά στον πάγκο πουλήθηκαν
The phrases from the book got translated	Οι φράσεις από το βιβλίο μεταφράστηκαν
The photos from the wedding got printed	Οι φωτογραφίες του γάμου τυπώθηκαν
The teachers from the school got fired	Οι δάσκαλοι από το σχολείο απωλήθηκαν
The chocolates in the box got eaten	Οι σοκολάτες στο κουτί φαγώθηκαν
The answers to the puzzle got given	Οι απαντήσεις του κουίζ χάθηκαν
The boys in the bar got drunk	Τα αγόρια στο μπάρ μέθυσαν
The cats in the yard got trapped	Οι γάτες στον κήπο παγιδεύτηκαν
The pages of the book got torn	Οι σελίδες του βιβλίου σκίστηκαν
The results from the exam got annulled	Οι απαντήσεις της εξέτασης ακυρώθηκαν

APPENDIX E

Materials for the Grammaticality Judgement Task used in Expts. 6 & 7

To avoid repetition we report that materials were identical to the English sentences we used for the experimental trials of the corresponding experiments (see Appendix C), except that we added correct and erroneous tag-questions. As in the previous grammaticality judgement tasks, participants were asked to circle which of the two sentences they considered grammatically correct:

A. The hair of the girl got wet, didn't they?
B. The hair of the girl got wet, didn't it?

A. The trousers of the boy got shrunk, didn't they?
B. The trousers of the boy got shrunk, didn't it?

A. The tree in the garden got sold, didn't it?
B. The tree in the garden got sold, didn't they?

A. The books in the library got stolen, didn't it?
B. The books in the library got stolen, didn't they?

APPENDIX F

Materials for the Grammaticality Judgement Task used in Expts. 8 & 9

To avoid repetition we report that materials were identical to the English sentences we used for the experimental trials of the corresponding experiments (see Appendix C), except that we added correct and erroneous tag-questions. As in the previous grammaticality judgement tasks, participants were asked to circle which of the two sentences they considered grammatically correct:

A. The wig of the girl got wet, didn't they?
B. The wig of the girl got wet, didn't it?

A. The shirts of the boy got shrunk, didn't they?
B. The shirts of the boy got shrunk, didn't it?

A. The tree in the garden got sold, didn't it?
B. The tree in the garden got sold, didn't they?

A. The books in the library got stolen, didn't it?
B. The books in the library got stolen, didn't they?